MSC-S R13.1 Blade Cluster Data Transcript

STUDENT BOOK
LZT 123 9083 R1A

DISCLAIMER

This book is a training document and contains simplifications. Therefore, it must not be considered as a specification of the system.

The contents of this document are subject to revision without notice due to ongoing progress in methodology, design and manufacturing.

Ericsson assumes no legal responsibility for any error or damage resulting from the usage of this document.

This document is not intended to replace the technical documentation that was shipped with your system. Always refer to that technical documentation during operation and maintenance.

This Student Book, LZT 123 9083, R1A supports course number LZU 108 7377 .

Table of Contents

1 Introduction

Objectives

Recognize MSC-S Blade Cluster advantages in GSM and WCDMA networks.

- Recognize the network architecture and components of the GSM/WCDMA network according to system documentation.

Figure 1-1: Objectives

Intentionally Blank

INTRODUCTION

MSC Server Blade Cluster (MSC-S BC) is the evolved version of Ericsson's Mobile Softswitch Solution's (MSS) MSC Server (MSC-S) providing a high-capacity, fully-scalable and future-proof solution offering a smooth migration path towards IMS.

In its nature MSC-S BC is built upon a scalable architecture, which combines the modern Integrated Site (IS) hardware concept based on a high-available blade architecture with the strength of Ericsson's well-established MSS solution.

This chapter shows the network view of an MSC-S BC introduction in an existing circuit switched core network and the connection towards 2G and 3G radio network.

MSC-S Blade Cluster is supported for markets following the ETSI standard for WCDMA and GSM.

Ericsson takes the MSS one step further by introducing MSC-S Blade Cluster. With MSC-S Blade Cluster, the server capacity is increased substantially, supporting up to 8 Million subscribers with only two single-depth cabinets, as well as significantly increasing the node availability. This allows an impressive network simplification and creates a network infrastructure that is easy to manage, always available and capable of adjusting to unpredictable future traffic increases and changing business needs.

MSC-S BLADE CLUSTER KEY BENEFITS

- Ultra high capacity:
  - up to 3 Million subscribers (MSC-S Blade Cluster Phase 1)
  - up to 8 Million subscribers (MSC-S Blade Cluster Phase 2)
- Outstanding system availability
  - zero down time on node level
  - enabling SW upgrade of single blades without traffic disturbance
- Easy scalability*
  - in steps of app. 500k subscriber by adding new blades
  - Blades can be added and removed without updating the configuration of neither radio nor core network.
- Future proof solution
  - Blades are generic process (GEP) boards that can be loaded with MSC-S software application as well as other applications like e.g. IMS
  - Enabling SIP/SIP-I inter-working*

*Note: the full implementation of this will be achieved from MSC-S Blade Cluster Phase 2 onwards)

Figure 1-2. MSC-S BC Key Features

LAYERED NETWORK ARCHITECTURE – MOBILE SOFTSWITCH SOLUTION

The main Mobile Softswitch Solution (MSS) functions can be subdivided into a part belonging to the network control layer and a part belonging to the connectivity layer implemented by the logical nodes MSC Server and MGw respectively.

Figure 1-3 below gives an overview about the logical entities of the Ericsson WCDMA/GSM core network as part of layered network architecture for the CS domain based on 3GPP Release 6. The shaded nodes are part of the CS domain. Not all interfaces are shown in order to keep the figure readable.

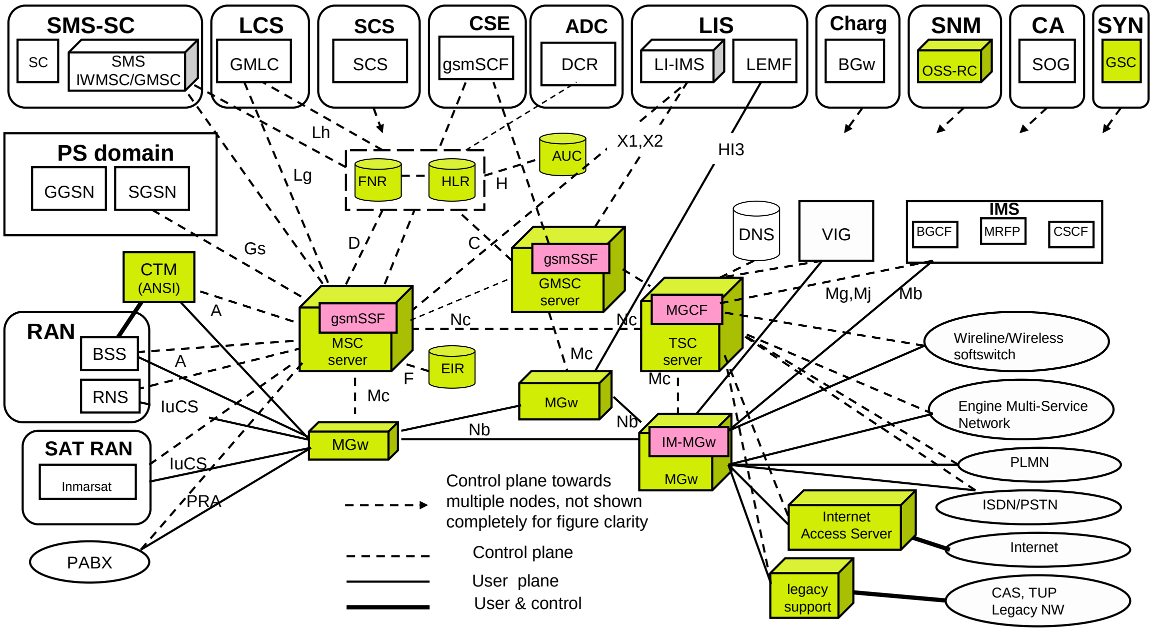


Figure 1-3. Layered architecture network overview

Note that nodes belonging to transport network, like Signaling Gateways (SGW), are not shown.

In addition to the network connections already mentioned connections to corporate access with PRA and connections to external networks like TSS, PSTN/ISDN networks and legacy networks are shown.

A short description of the Core nodes and some other important PLMN nodes is given below.

In the next diagram, figure 1-3 shows the MSC-S BC. It replaces the MSC-S/TSC-S and GMSC nodes showed in the figure 1-2.

MSC SERVER

A Mobile Services Switching Center Server (MSC Server) encompasses the network control layer part of the MSS. It is responsible for signaling only. It controls one or more M-MGw nodes by means of the GCP protocol. The MSC Server terminates the A-interface towards the GSM RAN, the IuCS interface towards the WCDMA RAN or both at the same time (Dual Access). It connects to the SGSN nodes in the PS domain via the Gs interface. It provides for a PRA interface and can be connected directly to a PABX. Thus the MSC server is characterized by its handling of a subscriber access, either a mobile subscriber or a PABX subscriber.

MGW

The MGw encompasses the connectivity layer part of the MSS. It is controlled by MSC Server nodes via the GCP protocol. The MGw is responsible for connections in the user plane. It supports media stream resources like transcoders, echo cancellers or announcements for speech calls and the interworking function for transparent and non-transparent data, video or FAX calls. The physical M-MGw node may also include node functions like SGw, AAL2 switch, ATM VC or TDM cross connect, which are part of the transport layer.

TSC SERVER

The Transit Switching Center Server (TSC Server) is part of the control layer. It can route a call inside the PLMN network using BICC and ISUP signaling. It can also act as a gateway providing BICC to ISUP conversion between the PLMN and external networks.

GMSC SERVER

A Gateway MSC Server (GMSC Server) is part of the control layer and is responsible for interrogation to the HLR. A standalone GMSC Server extends on the TSC Server functionality by the HLR interrogation function. The interrogation function can also be co-located within an MSC Server.

GSMSSF

The gsmSSF function entity is always integrated within an MSC Server or GMSC Server. This function entity is responsible for CAMEL support.

MGCF

The MGCF function entity will be integrated within all MSC Blades in R14.0. However, there is no specific interface between MGCF and TSC server. MGCF function provides control plane interworking between Core Network and IMS domain or other wireline/wireless softswitches using SIP-I. It also offers the possibility to interconnect IMS based networks with other SIP-I based VoIP solutions via the TSC Server.

All SIP/SIP-I functionality will be available in the MSC-S BC R14 and on.

IM-MGW

The IM-MGw function entity may be standalone or integrated within an MGW. IM-MGw function provides user plane interworking between CNCS and IMS domain or other wireline/wireless softswitches using SIP-I.

DNS

DNS is an Internet directory service. DNS is used to determine the IP address, server port and transport protocol from a domain name.

OSS-RC

OSS-RC supports sub-network management (SNM) functions for the CS core network. In addition also the PS domain nodes and other PLMN nodes like HLR/FNR are managed by OSS-RC.

SMS NODES

The two logical SMS nodes SMS-IWMSC and SMS-GMSC can be co-located with an MSC Server. However, in most cases they are not used since most SMS Service Centers (SMS-SC) are equipped with integrated SMS-IWMSC and SMS-GMSC functions.

INTERNET ACCESS SERVER

This is a 3PP node providing access towards the public Internet. The connection between the Internet Access Server in layered network architecture is via ISUP and TDM transport.

LEGACY SUPPORT NODE

Server nodes do not support conversion of legacy protocols like TUP or CAS to BICC. Therefore a separate node is used converting these legacy protocols to ISUP first.

The Ericsson Legacy Support Node is implemented by means of a TSC of the non-layered network architecture in most of the cases.

HLR/FNR/AUC/EIR

The Home Location Register (HLR) database stores and manages all mobile subscriptions belonging to a specific operator. The HLR stores permanent data about subscribers, including subscriber's supplementary services.

The database Authentication Center (AUC) is connected to the HLR. The function of the AUC is to provide the HLR with authentication parameters and ciphering keys. The AUC protects network operators from fraud.

The Flexible Numbering Register (FNR) provides mobile subscribers the ability to change network operator retaining the original directory number. The FNR Application reroutes messages to the appropriate HLR.

The Equipment Identity Register (EIR) provides a means for the network operator to control access to his network for specific MS/UE through the maintenance and interrogation of multiple lists of IMEIs.

MSC SERVER BC ARCHITECTURE OVERVIEW

The MSC Server BC provides mobile telephony functions based on a scalable cluster of MSC blades.

The high-level architecture of the MSC Server BC is shown in figure below. The figure depicts physical connections between the components.

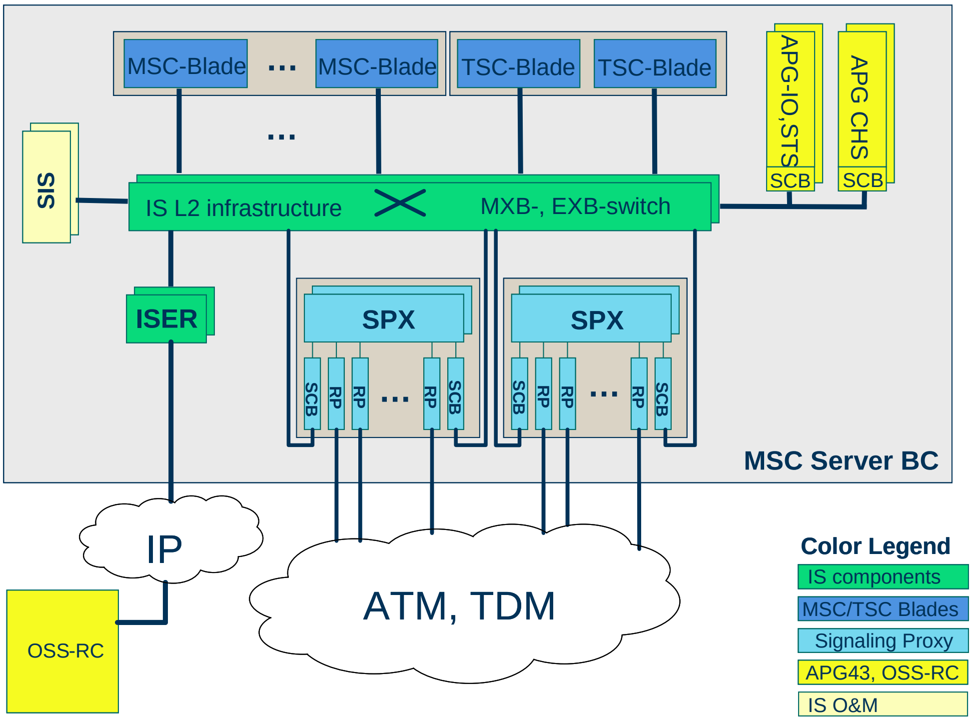


Figure 1-4. MSC BC Overview

The MSC Server BC consists of the following components:

- MSC blades
- TSC blades
- SPX (including RP equipment and SCB)
- APG-IO, STS and APG-CHS (including SCB) and
- IS (including ISER, SIS, EXB and MXB)

The MSC blades offer mobile call control functionality to/from the radio network.

The TSC blades offer TSC Server call control functionality to/from the core network.

The SPX terminates, converts, relays and distributes signalling traffic received from the network to the appropriate MSC or TSC blade.

MSC Server BC O&M functionality is provided by APG components and the OSS-RC (MSC Server BC external node).

OSS-RC is an own network node which supports operation and maintenance of the MSC Server BC.

The IS framework provides the Layer 2 and 3 infrastructure for the blades, incorporating ISER, SIS (for O&M of IS infrastructure), EXB and MXB components.

MSC SERVER BC COMPONENTS AND FUNCTIONS

MSC Blade

An MSC blade is a single sided, IS-adapted blade, configured to offer the following logical functionality:

- MSC Server
- GMSC Server
- SMS-IWMSC
- SMS-GMSC
- SSF/gsmSSF

The MSC Server BC uses the N+1 redundancy concept to protect MSC Server applications against (single) blade failure. The N+1 redundancy is implemented by the use of a primary MSC blade and a buddy MSC blade for each registered mobile subscriber. At (single) blade failure, all remaining MSC blades share the compensation of the unavailable MSC blade.

A primary MSC blade is one from two MSC blades that can handle a certain mobile subscriber. One of the MSC blades in the MSC Server BC is automatically selected as primary MSC blade for each mobile subscriber by the mobile subscriber distribution function. The primary MSC blade executes traffic for a mobile subscriber unless it experiences a transient failure or traffic isolation.

A buddy MSC blade is one from two MSC blades that can handle a certain mobile subscriber. One of the MSC blades in the MSC Server BC is automatically selected as buddy MSC blade for each mobile subscriber by the mobile subscriber distribution function. The purpose of the buddy MSC blade is to handle new traffic for a subscriber during traffic isolation or a transient failure of the primary MSC blade of the same subscriber.

From the two MSC blades that can execute traffic for a mobile subscriber (primary MSC blade and buddy MSC blade), a blade that actually handles the subscriber is the active MSC blade. The other one is the passive MSC blade.

During traffic isolation or at a transient failure, an MSC blade, by default, becomes a passive MSC blade for all mobile subscribers that are already registered on that blade.

Mobile originating calls towards external nodes are routed from the active MSC blade to a TSC blade based on the consistent cluster view. Mobile originating calls towards mobile subscribers served by another MSC blade are routed to this MSC blade. Mobile originating calls towards mobile subscribers served by the same MSC blade are handled by one and the same MSC blade.

The VLR data replication function makes the subscriber data of a mobile subscriber available in the VLRs of the primary and buddy MSC blade. In exceptional cases the VLR data replication might fail and, for these exceptional cases, consistency of certain data is not achieved (weak consistency). Cases of inconsistent data are detected and in such cases the stored data are discarded and new sets of data are fetched from the HLR and stored in the VLRs of the primary and buddy MSC blade to restore the data consistency.

Each blade is able to route subscriber related initial connection requests or dialog requests to the active MSC blade (primary or buddy MSC blade) in the MSC Server BC following the distribution of subscribers.

The mobile subscriber distribution function, which is located on the MSC blades (each MSC blade has a distribution function), uses load vectors to perform distribution of subscribers. A load vector is a logical representation of the cluster configuration and the load distribution within the MSC Server BC. The information of the load vectors is stored on all MSC blades and it is used by the distribution function to determine the primary MSC blade and the buddy MSC blade of a mobile subscriber. Different load vectors are used for this task. The load vectors are calculated based on the consistent cluster view information data set.

A transient failure of a blade is a temporary situation. During this situation, the blade is not able to execute traffic due to automatic recovery actions. If the primary blade transiently fails, its mobile subscribers can be handled by the buddy MSC blade. Once the buddy MSC blade has taken the control of a subscriber, it handles this subscriber until the next location update is received or until it becomes unable to execute traffic due to traffic isolation or due to a transient failure. At the occurrence of one of these events, the primary MSC blade will start to handle the subscriber again, unless the primary MSC blade is not able to execute traffic.

A permanent failure of an MSC blade is a failure that cannot be corrected by automatic recovery actions. A permanent failure of an MSC blade always leads to a cluster reconfiguration. New load vectors are calculated to reconfigure the cluster.

When traffic isolation is initiated, no new traffic is distributed to the MSC blade that is under traffic isolation, but existing traffic may be allowed to continue on that MSC blade. An MSC blade is traffic isolated when there is no traffic on it and new traffic is prohibited, except test calls. Only one blade can be isolated at a time.

TSC Blade

A TSC blade is a single sided, IS-adapted blade, configured to offer TSC Server call control functionality towards the core network and the MSC server applications (MSC blades). Its function within the MSC Server BC is to provide BICC, ISUP and China TUP connectivity towards peer core network nodes. The TSC blade terminates BICC, ISUP and China TUP protocols, whereas related traffic handling is performed at the MSC blades.

Based on the consistent cluster view, TSC blades distribute traffic with mobile number to the MSC blades. For mobile terminating calls with MSRN, calls are routed by the TSC blades to dedicated MSC blades based on the mobile subscriber distribution. TSC blades are able to handle transit traffic.

Two TSC blades are used within an MSC Server BC to achieve redundancy on network level.

When traffic isolation is initiated, no new traffic is distributed to the TSC blade that is under traffic isolation, but existing traffic may be allowed to continue on that TSC blade. A TSC blade is traffic isolated when there is no traffic on it and new traffic is prohibited, except test calls. Only one blade can be isolated at a time.

Signalling Proxy (SPX)

The Signalling Proxy (SPX) is based on a double-sided AXE CP with RP equipment and routes signalling traffic (based on TDM, ATM or IP) received from external network nodes to the appropriate MSC blade or TSC blade.

The main purpose of the SPX is to hide the blades from external network nodes.

For load sharing purposes, redundancy reasons and to avoid disturbances when software is updated on an SPX, two SPXs are used within an MSC Server BC.

Two SPXs achieve redundancy on network level, if remote peer nodes can be connected to both SPXs1.

All external, traditional SS7 signalling (MTP) and in addition M3UA/SCTP/IP is handled by these two SPXs, that is the SPX terminates and converts external signalling transport (SCCP/MTP to SUA/SCTP/IP or MTP/ATM, MTP/TDM to M3UA/SCTP/IP) within MSC Server BC. SUA/SCTP/IP and M3UA/SCTP/IP may be terminated and converted back to SCCP/MTP or MTP at the SPX for signalling transport towards external network nodes. M3UA/SCTP/IP may be relayed by the SPX. Except for SCCP as M3UA user, M3UA/SCTP/IP can optionally be connected directly to the blades, bypassing the SPX.

The SPX (including SCB) is connected by a layer 2 switch (EXB) and IS equipment (including MXB) to MSC blades or TSC blades.

SUA Signaling and other signaling issues will be detailed later on another chapter.

MSC Server BC O&M (APG and OSS-RC)

For the Operation and Maintenance (O&M) of the blades and the signaling proxies, at least two APGs are needed. One APG is meant for MML-IO and statistics, including back-up and reload. The second APG collects charging and accounting data from all the blades and the signalling proxies. SCCP and MTP accounting data are collected from both signalling proxies separately.

The MSC Server BC is administered via MML commands which are executed in each blade.

IO-Commands may address a specific blade or SPX, any subgroup of blades and SPXs (multicast) or all the blades and SPXs at once (broadcast). As soon as more than one single blade or a single SPX is addressed by an IO-command, a printout comparison function in APG, ensures that only one printout is provided, if the same printout is received from all addressed elements.

The Network Element Header, preceding the prompt or any result printout, carries the CP blade name or CP group name to specify the printout data origin.

The Network Element Header, preceding any spontaneous alarm printout carries the CP blade name to specify the printout data origin.

The element manager (WinFIOL 7.1 or higher) extends the command dispatcher and the printout comparison function provided by APG.

Integrated Site (IS) Infrastructure

The IS infrastructure consists of the following elements:

- SIS
- ISER
- MXB and
- EXB

It provides the main on site protocol layer 2 infrastructure for the MSC Server BC.

The IS is using Ethernet on the backplane for signalling traffic.

The Site Infrastructure Support System (SIS) enables booting and O&M (set-up and operation) of layer 2 infrastructure and components (as ISER). Two SISs are used to provide network redundancy.

The ISER connects the MSC Server BC to the IP network of the site. Two ISERs are used to provide redundancy.

IS uses layer 2 switches (MXB and EXB) and ISER to enable connectivity. Two EXB (used for IS-external linkage) and two MXB (used for IS-internal linkage) layer 2 switches are used to provide network redundancy.

EQUIPMENT (HARDWARE) MANAGEMENT

Figure below shows an overview of the MSC-S BC hardware. Note that this is only an example of one possible HW configuration (large configuration).

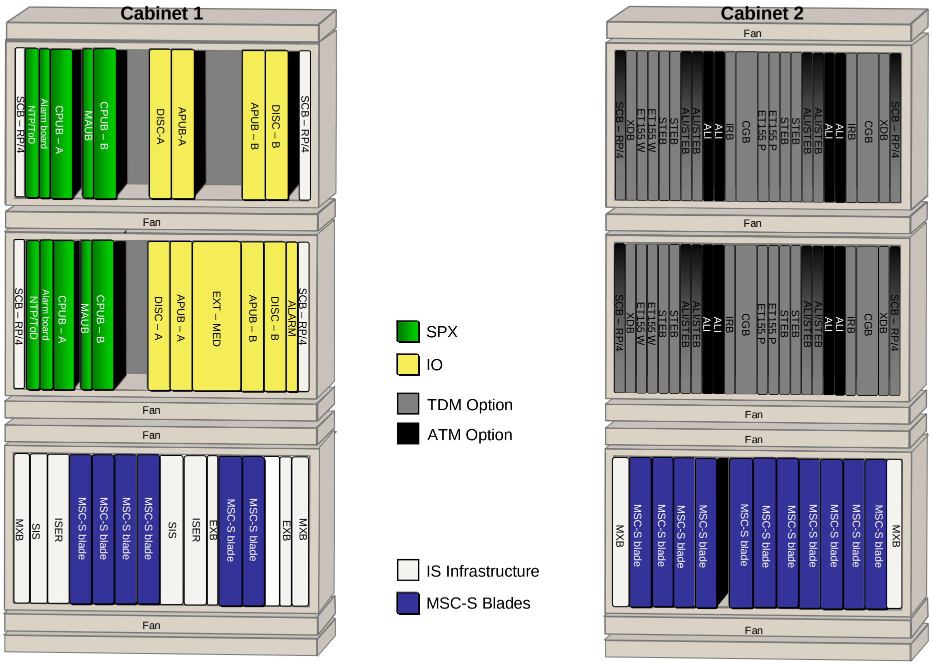


Figure 1-5- HW overview of one of the MSC-S BC Node configurations

The recommended tool for making initial HW configurations and to configure the IS O&M Domain is the ISM GUI. In the ISM GUI it is possible to view and to make initial configurations for all Blade Systems in the node.

After initial configuration of the MSC-S Blade System further APG O&M Domain HW configurations are to be done via WinFIOL. The application configurations can also be done from OSS.

SOFTWARE UPGRADE

The different Blade System, and Attached System (SPX and APG), entities have their own dedicated upgrade (and update) procedures and basically each entity have to be upgraded separately. Generally, the upgrade of the IS parts shall be done prior to the upgrade of the MSC parts.

The different Blade Systems and Attached Systems (SPX and APG) can be upgraded individually by means of their dedicated Element Managers. However, for the upgrade of the IS O&M Domain components it is recommended to use the ISM-UI, and for the upgrade of the APG O&M Domain, the OSS-RC Software Management Organizer (SMO) shall be used.

The ISM-UI provides support for downloading and changing software for the blade systems, however not for the blade systems belonging to the APG O&M Domain.

The OSS-RC SMO application provides support for the software transfer to the node and support for automated upgrade of the whole APG O&M Domain by means of OPS Scripts. The OPS scripts are run in the SMO either directly or at a later scheduled point in time. The progress is shown in SMO.

NODE BACKUP

From backup point of view, the IS O&M Domain software and the APG O&M Domain software have to be handled separately.

The IS O&M Domain can be backed up from the ISM-UI onto SIS. The backup contains only the configuration data and it can be made for only one Blade System at a time or for the whole IS site in one go. However, the Site backup will not contain a full APG O&M Domain backup. The backups are normally stored on the node but can also be sent further to external media by for example sftp. For more information about IS part backup see reference.

Backups for all APG O&M Domain components (MSC, SPX, TSC and APG) can be initiated from APG or from the OSS. In any case the backups will be handled by, and temporary stored on the APG. Each APG O&M Domain component will have its own backup file which is stored in its corresponding directory in APG. From the APG the backup files can be sent to an external media or server.

CONFIGURATION MANAGEMENT

The MSC-S BC node consists of the IS and MSC parts which are handled separately. Figure gives a high level view of this.

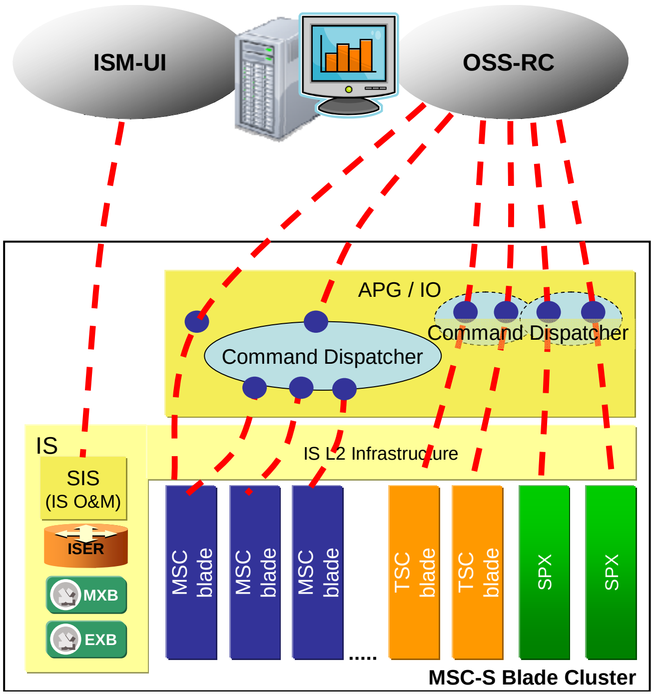


Figure 1-6 – IS and MSC parts of the Configuration Management for the MSC-S BC node.

The IS parts are the SIS, ISER, MXB and EXB. These are configured through the IS O&M Domain or the SIS. However, also the MSC BS contain some IS Infrastructure related functionality that has to be configured through the IS O&M Domain. The IS parts are configured either from an Element Management tool or from the ISM-UI. Some configuration tasks can only be performed using an applicable Element Management tool such as the CLI for ISER.

The APG O&M domain is configured through the APG in the MSC-S BC. They are configured either from an Element Management tool (WinFIOL) or from the OSS-RC. Basically, each blade is seen as a separate entity or “node”, it has its own configuration data and has to be individually configured. Generally, the recommendation is to keep the exchange data as equal as possible between the entities. That is, to define the same exchange data in all entities whenever applicable.

The DT course deals with this configuration, on MSC and TSC Blades and SPXes.

In order to ease the configuration of the MSC blades, and in order to keep the system more homogenous, a command dispatcher function is provided. With this function it is possible to configure MSC blades into CP groups. When a command is executed towards this group the command dispatcher copies and distributes the same command to all blades in the CP group. Each blade processes the command and replies to the dispatcher which collects the replies into one single answer. In case of deviations in the replies from the different blades, all replies will be included into the answer.

The command dispatcher function can be configured to cover also the TSC blades and SPXs, but maybe not always recommendable.

Intentionally Blank

2 Introduction to Data Transcript

Objectives

Understand the Data Transcript process according to system documentation.

- Explain the inputs and outputs of the Data Transcript process.
- Use the Customer Product Information (ALEX Document Browsers) in order to find appropriate commands, parameters and parameter values.

Figure 2-1. Objectives

Intentionally Blank

INTRODUCTION

Data Transcript is one of the activities required in the development, design and testing phases of producing a new product before it can be released. This product could be a new telephony application or extra functionality added to an existing application. Data Transcript is the process of producing Man-Machine Language (MML) commands. These MML commands are subsequently entered into an AXE telephone switch, allowing the AXE-switch to realize the designed functionality. Some of the commands will be the same in all AXE telephone exchanges, but many of the MML-commands will be different; differing for a number of switches running the same application, as well as switches running different applications.

The input requirements for any data transcript activity are principally the same for all telephony applications supported by Ericsson. The rest of the modules will look at the data transcript required for the mobile application. The data transcript will be built up on call types.

Figure 2-2 identifies the inputs and outputs required for the 'Data Transcript Process'. After the figure there is a description of each input and output.

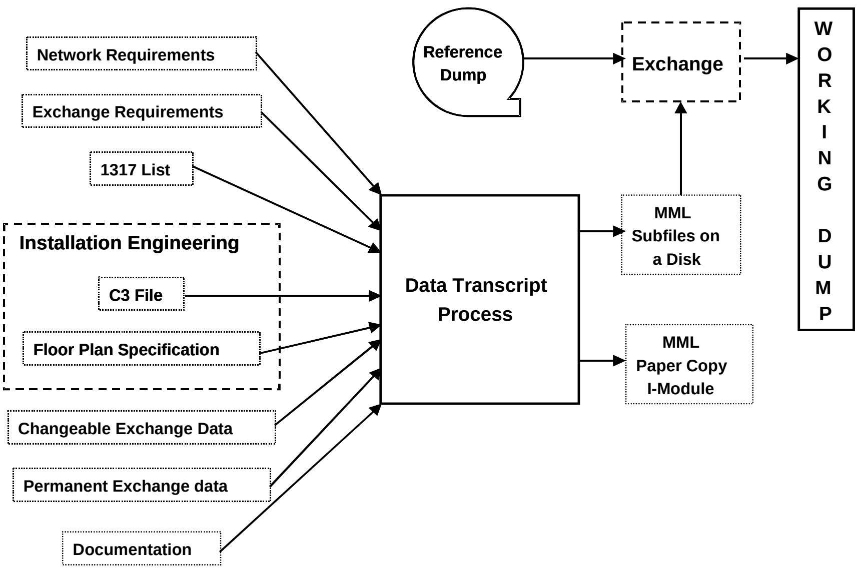


Figure 2-2: Input and Outputs of the Data Transcript Process

C3 FILE

The C3 file contains the allocation data relating to the “hardware” being installed. This information becomes subfile 20000. This subfile will define:

- The Regional Processors and the related software - EXRPI and EXRUI
- The Extension Modules – EXEMI
- The Group Switch – GDCOI (for classic MSC mainly)
- The Switching Network Terminals and the connection of the hardware - NTCOI and EXDUI
- The position of the hardware might be included – EXPOI

It can be seen from Figure 2-2 that the Installation Engineering (IE) supplies the C3 file. This C3 file will be unique for every switch being installed.

It is important to remember that certain commands, such as GDCOI and NTCOI have parameters (VAR for GDCOI and SNTV for NTCOI), where the value is dependent on the hardware being used. The software uses these parameter values when the hardware is being tested.

In the Application Information (AI) the correct parameter value will be found. This value will be used to carryout different test routines. Parameter values are specified by the IE department and should be correct. However, it is a good idea to compare these values against those specified in the AI against the hardware to be installed as described in the ‘Floor Plan Specification’.

Note: The Group Switch is an optional hardware in the MSC-S Blade Cluster solution and it is applicable only for SPX nodes. In fact it is just used in case TDM and/or ATM signaling in the MSC-S node is needed. Then, other hardware will be necessary as well such as STEB (narrowband/broadband TDM signaling board), ALI-E (ATM signaling board).

NETWORK AND EXCHANGE REQUIREMENTS

The network operator will place certain requirements on the software. These requirements can be divided into Network Requirements and Exchange Requirements.

NETWORK REQUIREMENTS

Network requirements will have been specified by the customer and will be on the reference dumps delivered to the site. For example, the network requirements could identify the frequency of the tone received for dial tone, or the inter-digit timeout. It could also affect certain changeable exchange parameters.

EXCHANGE REQUIREMENTS

Exchange Requirements (ERs) are unique to a switch and will determine how the exchange will fit into its environment. The ERs could be identified in a number of different ways. This course will show different examples and how they can be documented. An example of the simplified ER Form is shown below.

The ER form contains the minimum information required to produce the data transcript for a particular exchange and is collected from the operator prior to the Data Transcript been produced. The information will identify:

- The network and node Identification (signaling point codes etc)
- Naming Conventions.
- Which other nodes it interconnects with, both within the PLMN and PSTN
- The number series used within the PLMN
- The number series of the test phones (BL-phones) (for classic MSC nodes)
- Special number series in the PLMN/PSTN
- International roaming agreements
- Other equipment

The information contained within the ER form will include general data relating to a particular network operator and specific data for the new node, which is to be installed and brought into service. These forms will need to be completed for each new node being added to an existing network. If it is a new network, several of these forms will be required.

The end result will be the production of the MML (subfiles) required to bring the exchange into service.

1317 LIST

The 1317 List (Product Document List) is a document, which gives information about the products used in the application. For example, the product code for the APT source system would be identified. This product code would then be used to identify each of the subsystems by their name and their product number. Each subsystem is made up of a number of function blocks, again identified by name and product number. The function blocks are made up of function units. Again, their name and their product code identify these.

This document can also be used to find the correct Application Information document for a function block, as the 1317 List contains the product name as well as the product code.

Figure 2-3 shows an example of the product name, as well as the product code. The most interesting part, for example, would be the section showing the function block and then identifying the function units, which make up that particular function block. Notice that the two software function units, identified by CAA, have ‘U’ or ‘R’ at the end of their product name to identify that it is either Central or Regional software, respectively. Also note that the hardware, identified on this occasion by ROF, is realized by one of three Printed Circuit Boards (PCB); any one of them could be used.


```
---C  -------INCLUDED PRODUCT GROUPS----------------------------------------
        MAIN             AXE 106 30/6 =R1A
         2/AXE           2/AXE 106 30/A46 =R1A
        MAGAM            APR 101 49/7 =R1A
        BTAM             APR 101 36/3 =R1A
        IUSAM            APR 101 20/14 =R1A
        LSS              ANT 314 01/11 =R1A
        MDS              ANT 294 02/13 =R1A
        MMS              ANT 293 01/17 =R1A
        ...

--C  ------------PRODUCT GROUP: MAGAM   -------------------------------------
    MMS                  ANT 293 01/17 =R1A
        MRALT                        CNT 293 0349 =R1
        MRALTU                       CAAZA 107 2158 =R1A
        MRALTM                       CNT 293 0349 =R1
        MRALTMU                      CAAZA 107 2158 =R1A
        MALT                         CNT 293 0363 =R1
        MALTU                        CAAZA 107 2239 =R1A
        ETMALT                       CNT 212 2198 =R7
        ETMALTU                      CAAZ 107 2913 =R5A
        ETMALTR                      CAA 135 3024 =R3A
        ETC5                         ROJ 204 03/1 >R3A
        ...
```

Figure 2-3: 1317 List Product Code List

Example of using the 1317 List

In the network we shall be using Mobile Telephony Remote A Interface Terminal (MRALT). To find the correct document (Application Information) you need to know the device name or function block, the 1317 list can then be used to find the product code for the device type. Using the product code the A.I. for the correct block can be found.

The Application Information will give the corresponding block information, e.g. Size alteration event (SAE's), function codes (FNC)…The device type can also be obtained from the A.I. this is the device specified in the route definition:

EXROI:R =…..,DETY=MRALT;

Function block `MRALT` is part of the Mobile Mobility and Radio Subsystem (MMS) in Mobile Access and Gateway Application Module (MAGAM).

AXE PRODUCT STRUCTURE

The AXE product is divided into different sub-levels.

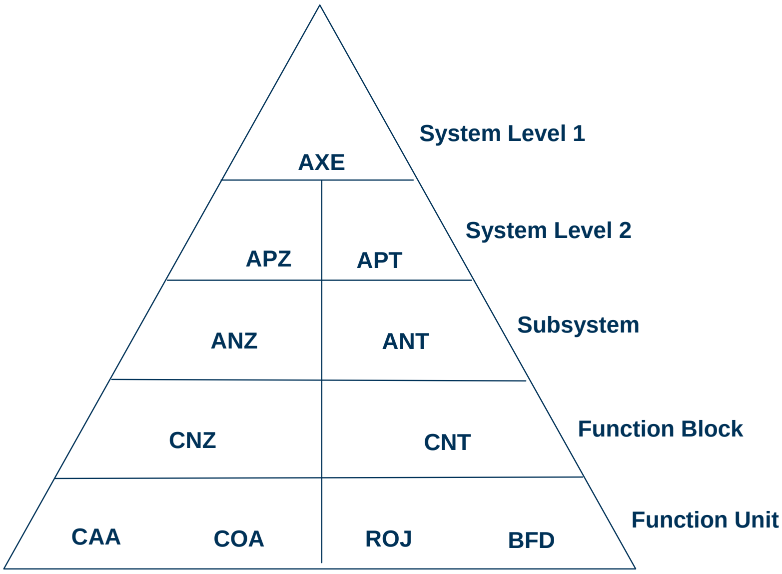


Figure 2-4: AXE Product

FLOOR PLAN SPECIFICATION

The ‘Floor Plan Specification’ is a document, which identifies the position a magazine has been allocated in a cabinet. This document also identifies, if applicable, the RP and EM designations of the hardware concerned. The product code of the hardware is useful when trying to find parameter values for the exchangeable exchange data, which are hardware dependent. The changeable exchange data is found in the Application Information for the specified function block. The Floor Plan and the C3 file should have identical information.

EXCHANGE DOCUMENTATION

The majority of operators use the Windows based program ALEX (AXE Library Explorer) in order to view the exchange documentation. ALEX can be installed locally on a Windows PC or on a server with access over the Internet or Intranet. The document books can either be stored locally on the computer or on a server. A browser, such as the Internet Explorer or Netscape is used to view the information.

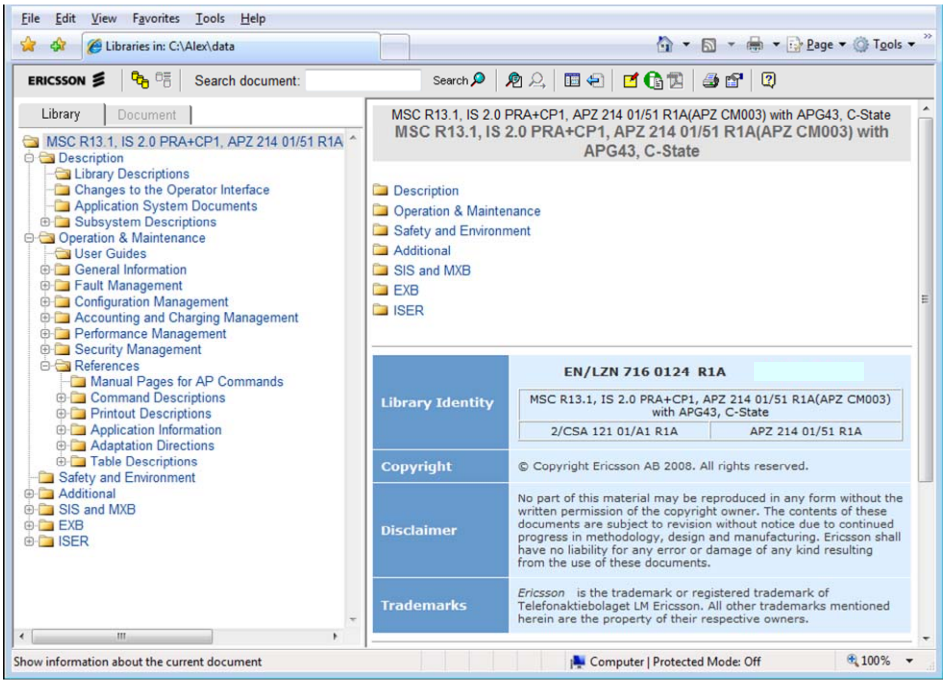


Figure 2-5: Active Library Exchange – Alex Documentation Browser

LIBRARY SURVEY (A-MODULE)

The Library Survey contains general information. In earlier syntax it was called the A-Module.

OPERATION & MAINTENANCE (B-MODULE)

The Operation and Maintenance Module will be the document that will probably be referenced the most. In earlier syntax it was called the B-Module. The B-module contains the following types of documents:

Operational Instructions – OPI

OPI is a set of instructions outlining the correct procedures to follow for operation and maintenance of the exchange.

OPI has a decimal class of 15 431.

Command Description – COD

Every command used in the application will be available. COD will show which parameters are to be used and which are optional.

COD has a decimal class of 19 082.

Printout Descriptions – POD

All Printouts that are obtained from the exchange will have a corresponding printout document. This could be useful to identify fault codes, for example.

POD has a decimal class of 19 083.

Adaptation Direction – ADI

ADI often has a more detailed explanation of the commands and parameters than that found in COD. This is a useful document if a more in-depth understanding of the command flow is required.

ADI has a decimal class of 15 542.

Application Information – AI

There is an AI for all function blocks that have changeable exchange data. This is a very important document that will contain the majority of the information required when specifying application specific information.

AI has a decimal class of 15 518.

SYSTEM DESCRIPTION (D-MODULE)

The D-module contains descriptions of the application from system level 1 at a very high level down to a function block level. This would usually be used for reference information only.

E-MODULE

The E-module contains all of the software, in Programming Language for Exchanges (PLEX) and Assembly Language (ASA). This module will be referenced to find the Permanent Exchange Data. The E-Module is generally not available for the network operator.

I-MODULE

The I-module contains all the data transcript files for the MSC-S BC start-up. This module is used by the deployment staff.

- Library Survey (A-Module)
- Operation & Maintenance (B-Module)
  - Operational Instructions (OPI)
  - Command Descriptions (COD)
  - Printout Descriptions (POD)
  - Application Directions (ADI)
  - Application Information (AI)
- System Description (D-Module)
- E-Module (Plex and ASA)
- I-Module (DT files)

Figure 2-6: Alex Structure

PERMANENT AND CHANGEABLE EXCHANGE DATA

The Exchange Documentation will be used to find both the Changeable Exchange Data and the Permanent Exchange Data.

PERMANENT EXCHANGE DATA

The E-module will be required to find the Permanent Exchange Data, the values of which are coded in the software, and can be found in the parameter lists.

CHANGEABLE EXCHANGE DATA

The B-module is used to find the Changeable Exchange Data. COD and ADI will be used to find which parameters are needed for a particular command, while AI will be used to find the correct parameter value for a parameter whose value is application dependant.

REFERENCE DUMP

The reference dump consists of the software for both the APZ and APT products as well as minimal exchange data to support the loading of the dump onto a new switch. The exchange data includes only APZ related information. For example, size alterations (SAE), the definition of SPG 0 (for IOG) or AP1 (for APG40) and also certain Alphanumeric Terminals (ATs) / Alphanumeric Devices (ADs) will be defined in the IO table.

For the dump to be useful, the MML-commands for the APT application also need to be loaded. The information is contained in a number of subfiles.

Examples of the subfiles are shown below:

Subfile Number	Name
9000.001	Mobile Telephony Feature Activation
10000.001	Size Alteration Events (SAE)
12000.001	Signaling Point and Supervision
13000.001	Mobile Telephony Exchange Properties
15000.001	End of Selection

Figure 2-7: Example of DT Subfiles

Subfiles are simply a group of commands that implement one or several similar functions. Collectively the subfiles form the I-Module (the complete data transcript file).

The subfiles will then be loaded onto the exchange from a terminal. In the previous figure shows just some of the APT data transcript. In fact, there will also be a need for creating subfiles to bring the equipment into services.

WORKING DUMP

The output of the data transcript process, the MML commands, combined with a reference dump form the working dump. This working dump is unique to each exchange within a network.

3 Classic Routes and Signaling Circuits

Objectives

MSC-S Blade Cluster Classic routes and signaling circuits

- Check the hardware definition for TDM narrowband and broadband signaling
- Verify the routes types in the MSC-S

Figure 3-1. Objectives

Intentionally Blank

INTRODUCTION

This chapter will use the Exchange Requirement (ER) forms, identifying to which nodes MSC is connected. This will include nodes to other networks as well as other nodes within the Home PLMN. By the end of the module the data transcript for connecting the speech and the signaling circuits will have been covered.

Much of the information in this chapter will have been discussed in previous AXE courses, and should therefore be a repetition. The beginning of this chapter contains sections, which should be familiar, while other areas might be new. The MML-commands needed to set up speech and signaling circuits are at the end of this module.

TYPES OF SIGNALING

“Signaling” refers to the transfer of control information either from a subscriber to an exchange or from one exchange to another. The purpose of signaling is to set up, supervise and disconnect telephone calls.

Signaling can be divided into two main categories: Subscriber Line Signaling and Inter-Exchange Signaling. In this module, we will focus on the Inter-Exchange Signaling, which involves signaling between exchanges. It is divided into:

- Channel- Associated Signaling (CAS).

- Common-Channel Signaling (CCS).

Figure below identifies the signaling used between MSC-S Blade Cluster and other nodes and networks. The signaling transport between MSC-S BC and the nodes are based on IP (SIGTRAN) an internally also IP (SUA/SIGTRAN). This subject will be treated later on.

The ISUP and BICC for example signaling protocol requires the Common Channel Signaling System No. 7 (C7 or SS7) to transport their message from one node to the other node.

CHANNEL ASSOCIATED SIGNALING

In channel-associate signaling, signaling is done in the speech channel itself (in-band) or in a channel closely (out-band) associated to the speech channel. Signaling and speech must take the same path through the network.

CAS uses in-band and out-band signals (in time slot 16 of the PCM system) to send information between two nodes. The information is sent using ‘Line Signals’ or ‘Register Signals’.

Line Signals can only use time slot 16 and can occur at any time during a call. An example of a line signal would be a SEIZURE SIGNAL.

Register Signals are used during the call set-up phase and take place over the timeslot allocated for the call. Register signaling has several different variants, some requiring extra hardware while some have the register signaling realized in the ETC. R2 MFC is a type of register signaling specified by the CCITT. An example of a register signal would be the sending of the B-Number.

R2 Signaling

R2 signaling is based on the Multi-Frequency Compelled (MFC) method, that is, the combination of two different frequencies to uniquely identify some information, for example a B-number. It will in future be referenced as R2 MFC.

To support R2 MFC signaling, extra hardware is required in addition to the ETC, which terminates the PCM system. This extra hardware is a Code Sender and Code Receiver (CS & CR) or a combined Code Sender and Receiver (CSR). The CS is used to send the R2 MFC signal from the originating exchange, whereas CR is used to receive the R2 MFC signal at the destination exchange. CSR is a combined piece of hardware, which allows it to act as a CS or CR depending on the direction of the call.

COMMON CHANNEL SIGNALING SYSTEM NO. 7

The Common Channel Signaling System No. 7 (C7) is a method of transferring signaling information between two signaling points. The signaling is performed over separate channels. It is divided into two main parts, with one part MTP (Message Transfer Part) which takes care of message transfer and another part UP (User Part) which is responsible for the exchange of these signaling messages). The following are some of the MTP user parts: ISUP (ISDN User Part), MAP (Mobile Application Part) and BSSAP (Base Station System Application Part). To support MAP, BSSAP and RANAP, SCCP (Signaling Connection Control Part) is needed, and also TCAP (Transaction Capabilities Application Part) is needed for the MAP.

The information, which is sent from one signaling point to another, could be related to a particular 64 kbps circuit. It could also be used to transfer information between two nodes not related to a circuit.

Circuit related signaling messages would typically be the setting up of a telephone call using ISUP.

Non-circuit related messages would be sending information related to a call already set up such as ISUP or checking subscriber information using MAP.

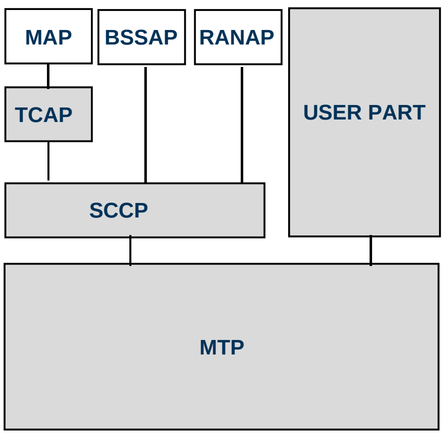


Figure 3-2: Component of Common Channel Signaling No. 7

Message Transfer Part

The purpose of MTP is to transfer information from one node to another, in a reliable way, ensuring that the message is received without any corruption, in the correct sequence and to the correct destination node. MTP has to provide the following five functions:

- Error Detection
- Error Correction
- Discrimination
- Distribution
- Routing

MTP is made up of three parts: the Signaling Data Link, the Signaling Link and the Signaling Network as shown in below.

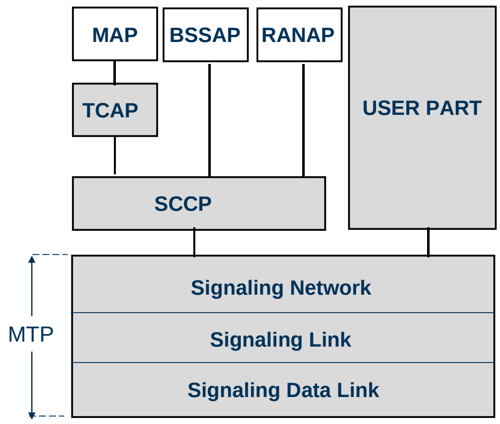


Figure 3-3: Components of the Message Transfer Part

- The Signaling Data Link is a bi-directional transmission path for signaling. In a PCM system using 32 channels, any of the 64 kbps circuits can be used as the signaling data link except time slot 0. ER will tell you which time slots to use.

- The Signaling Link provides a reliable link between two points directly connected together, transferring the signaling message between each point. The signaling link performs error detection as well as error correction on the signaling message being retransmitted.

- The Signaling Network is made up of the following two functions: the Signaling Message Handling and the Signaling Network Management. The Signaling Message Handling carries out message discrimination, message distribution and message routing. The Signaling Network Management controls the signaling traffic in case of congestion in the signaling data link.

The signaling message sent between two signaling points is carried in a Message Signal Unit (MSU). MSU is shown in the next figure.

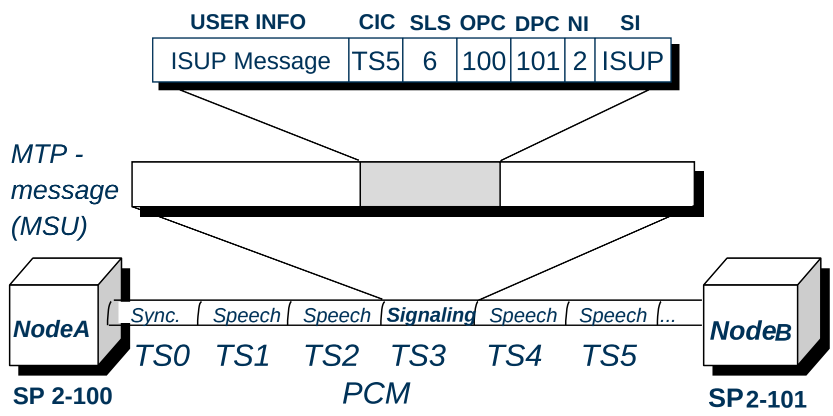


Figure 3-4: Contents of a Message Signal Unit

Since there are several users of MTP, for example, ISUP and SCCP, they can all send their signaling message using the same C7 signaling link. Therefore, a method is required to identify the user of MTP. To help the signaling message handling function distribute the message to the correct user, MSU contains a Service Indicator (SI) parameter which identifies the User of MTP. In Figure 3-5 the user of MTP is ISUP. The SLS values are used to distribute the load inside the Link Set (LS).

The Originating Point Code (OPC) identifies the originating signaling point of the message. The Destination Point Code (DPC) identifies the destination of the message. The TUP message relates to the 64 kbps circuit identified by the Circuit Identification Code (CIC). The Network Indicator (NI) identifies the signaling network to which this signaling belongs.

The SS7 (ANSI standard) messages format differs in length and an extra Message Priority field.

The commands to define MTP are shown in Figure below.

1. Own Signaling Point: **C7OPI, C7PNC.**
2. Signaling Points in Different Networks: **C7SPI, C7PNC.**
3. C7 Signaling Terminal Identity **C7STI..**
4. Definition of Link Set: **C7LDI.**
5. Definition of Signaling Links: **C7SLI.**
6. C7 MTP Routing: **C7RSI.**
7. Signaling Route Definition: **EXROI.**
8. Semi-Permanent Connection: **EXSPI, EXSSI EXSPE.**

Figure 3-5: Commands Defining the MTP Traditional SS7 Signaling Definition using TDM

Follow some command comparison about ITU-T/ANSI standards:

	Command (ITU-T and TTC signaling)	**Command (ANSI signaling)**	**Description**
Signaling point	C7SPP:SP=sp;	S7DEP:DEST=dest;	OWNSP, SP DATA
MTP Routing	C7RSP:DEST=dest;	S7RSP:DEST=dest;	Data, STATE
	C7RAI/C7RAE:DEST =dest;		Activation/Deactivation
	C7RUP:DEST=dest;	S7DSP:DEST=dest;	Supervision DATA
Link Set	C7LDP:LS=ls;	S7SLP:LS=ls;	DATA (LS, SLC, ST, SPID)
	C7LTP:LS=ls;	S7LTP:LS=ls;	STATE
	C7SUP:LS=ls;		Supervision DATA
Signaling Link	C7LDP:LS=ls;	S7LDP:LS=ls;	DATA (LS, SLC, ST, SPID)
	C7IHI/C7IHE:LS=ls, SLC=slc;	S7IHI/S7IHE:LS=ls, SLC=slc;	Inhibiting/Uninhibiting
	C7LAI/C7LAE:LS=ls, SLC=slc;	S7LAI/S7LAE:LS=ls, SLC=slc;	Activation/Deactivation
Signaling Terminal	C7STP:ST=C7ST2-x;	S7STP:ST=S7ST-x;	DATA (ST, RP/EM, LS, SPID, SLC)
	C7TSP:ST=C7ST2-x		STATE
	C7LDP:LS=ls;	S7LDP:LS=ls;	DATA (LS, SLC, ST, SPID)
	BLEMI/BLEME:EM=em,RP=rp;	BLEMI/BLEME:EM=em,RP=rp;	Blocking/Deblocking of ST (SLC must be deactivated)
	C7TDI:ST=C7ST2-x;	S7TDI:ST=S7ST-x;	ST Diagnostic (SLC must be deactivated)

Table 3-1. Signaling command comparison

Note: This overview does NOT replace any official Ericsson system documentation.

User Part

There are two User Parts, which are used in the PLMN for telephony connections, namely:

- The Telephony User Part (TUP) creates and interprets telephony signals for PSTN signaling, MSC to PSTN,
- The Integrated Services User Part (ISUP), creates and interprets telephony signals for ISDN signaling, MSC to MSC, MSC to ISDN.

Signaling Connection Control Part

The Signaling Connection Control Part (SCCP) offers other users access to the MTP network, for example, the Radio Access Network Application Part (RANAP) for communication between MSC Server and RNC, the Mobile Application Part (MAP) + the Transaction Capability Application Part (TCAP) for communication between Switching System nodes, for example, VLR to HLR.

Transaction Capabilities Application Part

The Transaction Capabilities Application Part interfaces MAP messages towards SCCP. MAP will be the signal message, while TCAP will carry the information from one node to another; it could be MSISDN when GMSC asks HLR for a routing address.

ROUTES

The definition of a route is 'a group of devices each having the same qualities’. By qualities we mean destination, device type, signaling system and any other characteristics.

There are collectively three groups of routes in AXE:

- Software Routes
- Internal Routes
- External Routes

Routes are defined using the EXROI command. If route characteristics require changing, the EXRBC command would be used. This is true for all route types.

The allocation of the devices (remotely or locally hardware) to the routes is carried out with the EXDRI command.

For example: If two PCM systems exist between the same MGW node, one-system supports CAS and the other C7, then by definition two routes need to be defined. This is because different signaling systems are being used and therefore different device types are required.

When wanting to find the correct parameters we consult Application Information (AI) for the 'route owning block'. In this case the 'route owning block' is the name of the device type. Therefore if two different device types are used, two different AIs will be required – each containing specific information for that particular block.

SOFTWARE ROUTES

Software routes are required to allow certain functions to work; they point to the function block in the software that will implement the function. The main function blocks that require a software route to be defined are shown in the next figure.

Note: Software routes do not require any hardware to be defined. For this reason the EXDRI command is not used when defining software routes.

GRI	GMSC Roaming Interrogation
GRR	GMSC Roaming Rerouting
IA	Interface Analysis
MRNR	Mobile Telephony Roaming Number Routing
MRR	Mobile Telephony Roaming Rerouting
MTB	Mobile Telephony B-Subscriber Traffic Coordinator
MIN	Mobile Telephony Intelligent Network
MSMO MSMT IWSMS GSMS	Function Blocks for SMS Handling

Figure 3-6: Routes Examples of Software Route type

All of these routes will be defined using commands EXROI and in some cases EXRBC will be required (to change default values).

Note: Some of the routes have a parameter MIS3 that has a meaning of either activating or deactivating certain parameters, for example, the BO parameter. To find the parameters to be used and the use of MIS3 consult AI for the route owning block.

GRI - GMSC Roaming Interrogation

The GRI route is required when the GMSC Server needs to consult HLR to find a routing address so that the call can be set up. There is an MIS3 parameter in this route that activates/ deactivates parameters: BO, CO, MIS1 and MIS2. The definition of this route will be dealt with in more detail in a later module. Consult AI.

GRR - GMSC Roaming Rerouting

The GRR function coordinates roaming rerouting of a call from a MSRN or call forward if the subscriber has the Call Forward Unconditional (CFU) supplementary service active.

IA - Interface Analysis

The IA function block has an interface to TCS allowing access to the A-number and B-number analysis tables. Inputs to IA would be the B-number, B-origin (BO) and the A-number. The output is the Charging Case (CC), and the A-Charge Origin (ACO).

MRNR - Mobile Telephony Roaming Number Routing

The routes defined to the MRNR function block are used for the allocation of an MSRN, for a call being set up and for allocating a Hand-Over Number (HON), for inter MSC handovers.

The route name for MSRN would typically be MRNRx while for HON it would be HOVERx, where ‘x’ would be a specific number. Each route has 100 MSRNs or HONs associated to it. For example, if 300 MSRNs are required, three routes are needed: MRNR0, MRNR1, MRNR2.

MRR - Mobile Telephony Roaming Re-routing

The MRR Function block handles conditional call forwarding in MSC/VLR, Call Forward on Busy (CFB), Call Forward on No Reply (CFNRY) or Call forward on Not Reachable (CFNRC). The MIS3 Parameter is used for this route to activate/deactivate the CO and RO parameters.

MTB - Mobile Telephony B-Subscriber Traffic Coordinator

This function block is the main coordinating block to set up a call to the B-subscriber. The MIS3 Parameter is used to activate/deactivate the BO parameter. The BO Parameter is used if airtime charging is required.

MIN

This function block coordinates the handling of the Messages for intelligent network functions. It manages data for routing calls to the Intelligent Network (IN).

MSMO, MSMT, IWSMS GSMS

These blocks coordinate the handling of the Short Messages. They read data from and load data into the Transaction Capabilities Application Part (TCAP) buffer (C7 signaling) and analyze received parameters.

INTERNAL ROUTES

The following routes require hardware to support the function. In each one of the following routes the hardware is allocated only if the function has been requested and then on a per call basis. Some of the equipment will be allocated for the duration of the call while other equipment is used only for the call set up. It is advisable to consult AI for the route owning block.

The following routes shall be defined with EXROI commands (and where necessary EXRBC) and the hardware is located in the MGW node.

In Classical MSC/VLR the command EXDRI is needed to allocated the corresponded hardware. For MSC-S BC the hardware is located in the M-MGW therefore EXDRI is not used.

CCD	Conference Call Device
CSR	Code Sender and Receiver
MDTMF	Mobile Telephony DTMF Sender
MIWUTH	Mobile Telephony Interworking Unit Device Handler
ECDH	Echo Canceller Device Handler
INTRO	Internal Trunk Route between blades

Figure 3-7: Routes Examples of Internal Route type

CCD - Call Conference Device

The CCD Function block is used to support supplementary services: the Multi Party Call (MPTY), the Call Waiting (CAW) and the Call Hold (HOLD).

CSR - Code Sender and Receiver

The code senders and receivers are required to support the R2 MFC signaling. Their use and connection is explained further in this chapter.

MDTMF - Mobile Telephony DTMF Sender

The MDTMF block contains functions for operating and supervising the Dual Tone Multi-Frequency (DTMF) sending Hardware.

MIWUTH - Mobile Telephony Interworking Unit Traffic Handler

The block handles Data Transmission Interworking Unit (DTI2) devices.

INTRO – Internal Trunk Route

The function block INTRO acts as an internal trunk for interconnecting the blades within the cluster. The block works in two different modes (incoming mode and outgoing mode), the outgoing INTRO and the incoming INTRO on different blades communicate with each other as counterpart. The block uses Open Intranode Protocol (OIP) in the interface to TRAM and Internal Trunk OIP (INTROIP) in the interface to the remote blade.

Echo Canceller Concept

In a telecommunication network the speech signals can suffer from an echo effect. The most common source for echo is the connection (hybrid) between the 4-wire transmission network and the 2-wire line to a PSTN subscriber. Other causes are long distance connections like satellite links and also the speech and channel coding used in digital cellular systems.

This type of echo canceller, the hardware is only connected in circuit if it is required. The echo canceller devices are in the MGW node.

Every connection between the digital cellular phone and a PSTN phone needs to have the echo effects reduced to achieve an acceptable quality of speech.

Echo cancellers are required for all telephony calls being routed to or through networks other than a digital mobile network. Data calls, that is, calls using the DTI, do not require echo cancellers to be in circuit.

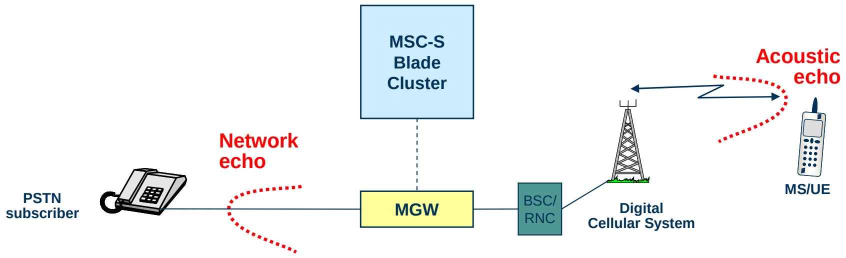


Figure 3-8: Echo Cancellers Concept

Every call requires an Outgoing Echo Canceller (OEC) and an Incoming Echo canceller (IEC). MS has a built in echo canceller and will automatically insert OEC for a mobile originated call and likewise IEC for a mobile terminated call. The network then needs to provide the 'other' echo canceller. For example, for an outgoing call the mobile inserts the OEC and the network needs to provide an IEC.

The parameters are shown in Figure below.

ESS Echo Suppressor Subsequent

0 No IEC available in succeeding exchange.
1 IEC available in succeeding exchange.

This parameter is set in the routing case analysis (ANRSI) and gives information whether an IEC can be expected to be available in any succeeding exchanges. If not, no request for an IEC connection is sent further and an IEC is connected in own exchange.

ESR Echo Canceller Required

0 OEC not required
1 OEC required in own or preceding exchange.
2 OEC required in own or succeeding exchange.
3 OEC required in own or preceding exchange (OEC is always enabled)

This parameter is set in the routing case analysis (ANRSI) and gives information on whether an OEC is required for a specific destination.

IECREQ Incoming Echo Canceller Requested

0 No IEC requested
1 IEC requested

This parameter is set for incoming routes (EXRBC) from nodes that have no signaling capabilities to transfer requests for echo cancellers. IECREQ indicates whether or not the PLMN should connect an IEC for an incoming call on this route.

Figure 3-9. Echo Canceller Parameters Changed by Command

The meanings of the parameters shown in Figure above are found in the AI for RA and the route owning block.

Other parameters that are used are shown in Figure below.

ESI Echo Suppressor/Canceller Information

0 No EC required.
1 OEC included, IEC requested.
2 OEC requested.

This is a parameter that is derived from the Initial Address Message (IAM) and address Complete Message (ACM) sent between exchanges at call setup. It specifies the sending exchange's requests for echo cancellers.

EXSIGN Information on origin of EC information

0 Backward request for OEC is not possible.
1 Backward request for OEC is possible.
2 No backward request. OEC included mobile originated call.
3 No OEC backward request, BL originated call.

This is not definable trunk data. This parameter gives information on the possibility of requesting an OEC from the preceding exchanges during call setup if it was not provided. ECSIGN also gives information whether the call was mobile originated or BL originated. The parameter is set by software based on the information received during the call setup process.

Figure 3-10. Non-Changeable Parameters for Echo Cancellers

EXTERNAL ROUTES

External routes point to equipment that leaves the exchange. This must be to a PCM system. The PCM system could support CAS signaling or C7 signaling. To support the different signaling systems, different device types are required.

Some examples of the devices used for external routes are:

- BSC – These routes require the MRALT device type (for MSC-Server) between MSC-S and BSC.
- RNC – These routes require the MUIUCM devices type between MSC-S and RNC.
- PSTN/ISDN Networks – These routes require UPDR (MSC-Servers). UPD type devices are User Physical Devices and are used towards fixed networks.
- MSC-Servers – There routes require the BID devices type between MSC-Servers.

The remote devices such as MRALT or UPDR and BID will be detailed in the following chapters in this book. When local devices are used, the optional hardware/subrack is needed.

The external routes directed towards other exchanges must have the correct device type selection, since the signaling system could be either C7 or CAS and the device type might require echo cancellers or not. Also the device type name can vary from market to market. To help selecting the correct device type the reference must be made to ER and also to the 1317 list, as the 1317 list is application specific.

DATA TRANSCRIPT

In the next two sections, examples of data transcript will be given for the definition of MTP, the definition of routes to support different signaling protocols and the hardware allocation to the routes (optional hardware). The definition examples given are only for internal routes and external routes.

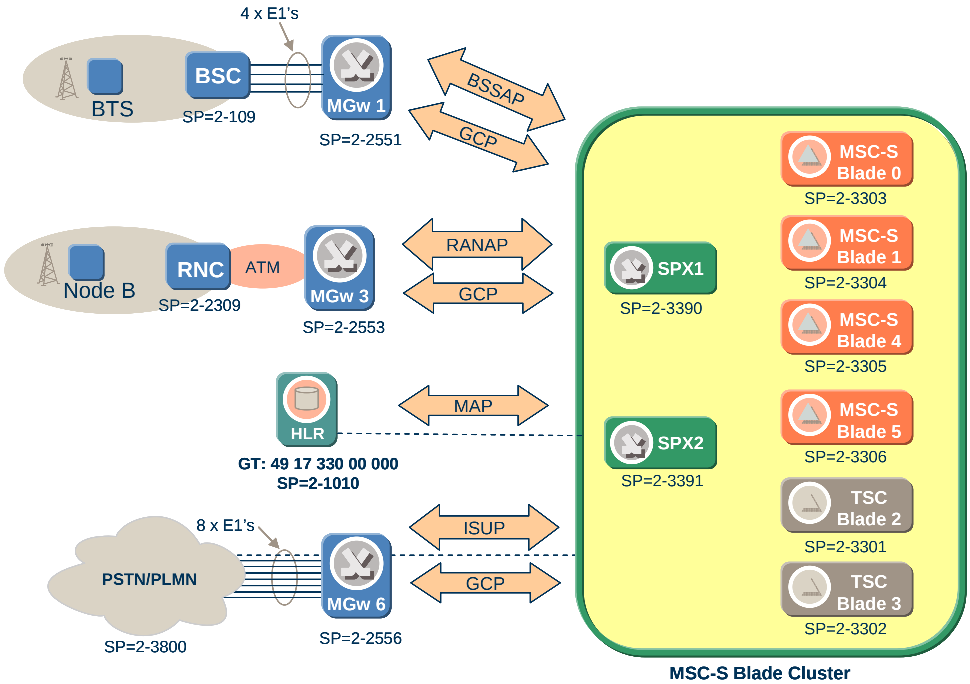


Figure 3-11: Network Plan

Figure above shows the information relating to MTP, routes and allocation of hardware. The dotted lines represent signaling routes only, whereas the solid line denotes a traffic and signaling route. Here it will be defined the TDM signaling only as IP signaling transport is treated in the next chapter.

DATA TRANSCRIPT FOR MTP

The data transcript shown in the network plan and the next figure show the commands necessary for implementing MTP (TDM) between our node MSC-S BC and other nodes in such as PSTN/PLMN (SP=2-3800) and HLR (SP=2-1010). With few exceptions MTP part is only necessary to define in SPX.

Figure below shows the data required when the signaling terminal (ST) is of the type C7GST. This ST is implemented by STEB board. STEB boards support narrowband and broadband signaling transports. STEB is connected in the GEM magazine and via backplane to the group switch (XBD boards).

The information below is from the MSC-S BC point of view:

- Own Signaling Point Code for SPX1: 2-3390
- Own Signaling Point Code for SPX2: 2-3391
- Own Signaling Point Code for TSC1: 2-3301

- Own Signaling Point Code for TSC2: 2-3302
- Signaling Point Code for HLR: 2-1010, LS=2-1010
- Signaling Point Code for PSTN/PLMN: 2-3800, LS=2-3800

```
!*****DEFINE SIGNALING TERMINAL OF STEB TYPE*****!
EXRPI:RP=40, TYPE=RPALI1E; !STEB Board!
EXRPI:RP=41, TYPE=RPALI1E; !STEB Board!

EXRUI:RP=40&41, SUID="9000/CXC 146 05 R1A03";
EXRUI:RP=40&41, SUID = "9000/CXC 146080 R4A03";
EXRUI:RP=40&41, SUID="9000/CXC 146 03 R1A08";
EXRUI:RP=40&41, SUID="9000/CXC 146 153       R1A04";

EXEMI:EQM=C7GST-   0&&-127,    RP=40,     EM=0;
EXEMI:EQM=C7GST- 128&&-255,    RP=41,     EM=0;

BLEME:EM=0,RP=40;
BLEME:EM=0,RP=41;

BLRPE:RP=40;
BLRPE:RP=41;

NTCOI:SNT=G7SNT-0, SNTP=XM-0-0- 2, SNTV=1, MODE=128;
NTCOI:SNT=G7SNT-1, SNTP=XM-0-0- 3, SNTV=1, MODE=128;

EXDUI:DEV=C7GST- 0&&-127;
EXDUI:DEV=C7GST-128&&-255;
```

Figure 3-12: STEB Definition DT Required to define the RPs for Signaling

The data transcript for defining the semi-permanent connection is also required.

```
!***** C7 OWN SIGNALING POINT *****!
C7OPI:OWNSP=2-3390, SPTYPE=SGW;
C7PNC:OWNSP=2-3390, SPID=SPX390;

!***** C7 SIGNALING POINTS IN OTHER NETWORKS *****!
C7SPI:SP=2-3800,OWNSP=2-3390;
C7PNC:SP=2-3800,SPID=PSTN;

!***** C7 SIGNALING TERMINAL IDENTITY *****!
C7STI:ST=C7GST- 0, ITYPE=16;
C7STI:ST=C7GST- 1, ITYPE=16;
…
C7STI:ST=C7GST-127, ITYPE=16;

!***** DEFINITION OF LINK SETS *****!
C7LDI:LS=2-2556;     !PSTN via MGW6!

!*****SIGNALING LINK DEFINITION *****!
C7SLI:LS=2-3800,SLC=0,ST=C7GST-0, ACL=A1,SDL=”PSTN-0,C7GST-0, UPD1-1”;
C7SLI:LS=2-3800,SLC=1,ST=C7GST-1, ACL=A1,SDL=”PSTN-1,C7GST-1, UPD1-33”;
C7SLI:LS=2-3800,SLC=2,ST=C7GST-2, ACL=A1,SDL=”PSTN-2,C7GST-2, UPD1-65”;
C7SLI:LS=2-3800,SLC=3,ST=C7GST-3, ACL=A1,SDL=”PSTN-3,C7GST-3, UPD1-97”;

!***** C7 MTP ROUTING SEPCIFICATION *****!
C7RSI:DEST=2-3800,LS=2-2556, PRIO=1; !Via MGW6!
```

Note: It should also define it on SPX2 changing OWNSP value.

Figure 3-13: MTP Definition MSC-S BC (SPX1) to the PSTN

```
!**** SEMI-PERMANENT CONNECTIONS ****!
EXSPI:NAME=PSTN-0;
EXSSI:DEV1=UPDR-1;
EXSSI:DEV2=C7GST-0;
EXSPE;

EXSPI:NAME=PSTN-1;
EXSSI:DEV1=UPDR-33;
EXSSI:DEV2=C7GST-1;
EXSPE;

EXSPI:NAME=PSTN-2;
EXSSI:DEV1=UPDR-65;
EXSSI:DEV2=C7GST-2;
EXSPE;

EXSPI:NAME=PSNT-3;
EXSSI:DEV1=UPDR-97;
EXSSI:DEV2=C7GST-3;
EXSPE;

EXSCI:NAME=PSTN-0, DEV=UPDR-1;
EXSCI:NAME=PSTN-1, DEV=UPDR-33;
EXSCI:NAME=PSTN-2, DEV=UPDR-65;
EXSCI:NAME=PSTN-3, DEV=UPDR-97;
```

Note: It should also define it on SPX2.

Figure 3-14: Semi-Permanent Connections MSC-S BC (SPX1) to the PSTN

HIGH SPEED SIGNALING LINK (HSL)

The feature makes it possible to concentrate the SS7 signaling links thus providing high capacity signaling links and leading to better cost-efficient network control and flexible network planning. It also accommodates the need for increased signaling capacity, mainly due to more extensive use of IN and SMS services. In larger networks the feature allows flexible network planning, especially when using Signaling Transfer Points (STPs). Using HLR redundancy will enable more subscribers in an HLR, and thus require more signaling capacity between the MSC and the HLR.

With the HSL there is also a reduction in the signaling delay.

The O&M of HSL follows the same principles as for conventional low-speed links.

HSL occupies a full 2 Mbit/s (ETSI) or 1,544 Mbit/s (ANSI) link, compared with a 64 kbit/s (ETSI) or 56 kbit/s (ANSI) channel. The signaling capacity is therefore increased 30 (ETSI) or 24 (ANSI) times on the physical layer.

HSL supports ETSI, ANSI, TTC and Q.703 Annex A signaling.

The HSL terminal exists in two versions. The STEB based version is an enhancement in MSC-S R13. The RPP based version is not used in new node deliveries anymore.

RPP based

The RPP based HSL is housed in the GDM-H magazine and it may coexist in the same node with the 64 kbit/s (ETSI) or 56 kbit/s (ANSI) narrowband signaling terminals. It is implemented on the RPP board, one RPP can handle one HSL. The hardware required is reduced by 75% compared to conventional signaling terminals.

The hardware platform used for the HSL C7 application is the Regional Processor with the Peripheral Component Interface – RPP, and the signaling terminals for HSL are C7STH devices. Device 0 will be reserved for hardware supervision and device 16 will be unused. All 32 STs must be connected to the same EM.

STEB based

The STEB is connected to the central processor via either the RPB-S or the RPB-E. It is housed in the GEM magazine and it is connected to the GS via the DL-34 interface. One board supports a maximum of 4 HSL. This maximum number is only usable in combination with the RPB-E, otherwise the RPB-S will limit the usable bandwidth. All new MSC Server deliveries will use the RPB-E, the RPB-S is only supported to allow extension of older MSC Server versions.

The HSLs can be used in various nodes, for example HLR, MSC and AUC, where there is a requirement for high amounts of signaling. The commands used are the C7 commands already discussed.

However, it is important to notice that the ITYPE parameter is given a value of H’1A for HSLs.

The NUMCH parameter specifies the number of 64 kbps channels to be defined. The number can be set from 2 to 30. By specifying 30, all available channels will be used for signaling (device 1 to 15 and 17 to 31).

Figure below gives examples of data transcript for the definition of a High Speed Signaling Link (HSL) from MSC-S BC to HLR2.

```
!*****DEFINE SIGNALING TERMINAL OF STEB TYPE*****!
EXRPI:RP=42, TYPE=RPALI1E; !STEB Board!
EXRPI:RP=43, TYPE=RPALI1E; !STEB Board!

EXRUI:RP=42&43, SUID="9000/CXC 146 05 R1A03"; ! RPFDR!
EXRUI:RP=42&43, SUID="9000/CXC 146080 R4A03"; ! RAEXR!
EXRUI:RP=42&43, SUID="9000/CXC 146 03 R1A08"; ! RPIFDR!
EXRUI:RP=42&43, SUID="9000/CXC 146 154 R1A04"; ! C7GSTHR!

EXEMI:EQM=C7GSTH-   0&&-127,    RP=42,     EM=0;
EXEMI:EQM=C7GSTH- 128&&-255,    RP=43,     EM=0;

BLEME:EM=0,RP=42;
BLEME:EM=0,RP=43;

BLRPE:RP=42;
BLRPE:RP=43;

NTCOI:SNT=G7SNTH-0, SNTP=XM-0-0- 4, SNTV=1, MODE=128;
NTCOI:SNT=G7SNTH-1, SNTP=XM-0-0-15, SNTV=1, MODE=128;

EXDUI:DEV=C7GSTH- 0&&-127;
EXDUI:DEV=C7GSTH-128&&-255;
```

Note: It should also define it on SPX2.

Figure 3-15: High Speed Signaling Link Data MSC-S BC (SPX1) to the HLR2

```
!***** C7 SIGNALING TERMINAL IDENTITY *****!
C7STI:ST=C7GSTH- 0, ITYPE=26;
C7STI:ST=C7GSTH- 1, ITYPE=26;
…
C7STI:ST=C7GSTH-127, ITYPE=26;

!***** DEFINITION OF LINK SETS *****!
C7LDI:LS=2-1010; !PSTN!

!*****SIGNALING LINK DEFINITION *****!
C7SLI:LS=2-1010,SLC=0,ST=C7GSTH-1, ACL=A1,SDL="HLR-0,C7GSTH-0, UPDR-257";

!***** C7 MTP ROUTING SEPCIFICATION *****!
C7RSI:DEST=2-1010,LS=2-1010, PRIO=1; !Direct Link !

EXSPI:NAME=HLR-0,NUM=30;
EXSSI:DEV1=UPDR-257;
EXSSI:DEV2=C7GSTH-1;
EXSPE;
EXSCI:NAME=HLR-0, DEV=UPDR-257;
```

Note: It should also define it on SPX2.

Figure 3-16: HSL Semi-Permanent MSC-S BC (SPX1) to the HLR2

DATA TRANSCRIPT FOR THE DEFINITION OF ROUTES AND ALLOCATION OF HARDWARE

Routes Supporting ISUP Protocols

From figure below it can be seen that the connections from MSC-S BC to PSTN/ uses the ISUP protocol. The device type used is UPDR (ET1551 board). This device type supports the ISUP signaling protocol and does not have echo cancellers. Note that the UPDR devices are related to the Remote devices placed in the MGW nodes.

In the examples shown in figure below, all routes, whether for speech or signaling, are both-way routes. In this situation both the outgoing and incoming routes are defined together; the first named route will always be taken as the outgoing route name.

The Function Code (FNC) tells the system what type of route is being defined. If FNC=3, the routes are defined for speech, and if FNC=7, the routes are defined for signaling. Remember that these values are only applicable for the UPDR device type.

Note: The parameters assigned in the next figure are only example values and should not be assumed to be standard when defining routes of this type. The ISUP route is handle by the TSC Blades only.

```
!**** ROUTES TOWARDS PSTN ****!
EXROI:R=PSTN1O&PSNT1I, DETY=UPDR, FNC=3, SI=ISUP4, SP=2-3800;
EXRBC:R=PSTN1O, TTRANS=1;
EXRBC:R=PSTN1I, BO=1, CO=31, PRI=10;

EXROI:R=PSTN1SO&PSNT1SI, DETY=UPDR, FNC=7;
EXRBC:R=PSTN1SI, PRI=10;

!**** ROUTES TOWARDS MSC1 HARDWARE ALLOCATION ****!
EXDRI:R=PSTN1O&PSTN1I,DEV=UPDR-2&&-31,MISC1=2,MISC2=0;    !PCM 1 SIG.T/S 1!
EXDRI:R=PSTN1O&PSTN1I,DEV=UPDR-34&&-63,MISC1=34,MISC2=0;  !PCM 2 SIG.T/S 1!
EXDRI:R=PSTN1O&PSTN1I,DEV=UPDR-66&&-95,MISC1=66,MISC2=0;  !PCM 3 SIG.T/S 1!
EXDRI:R=PSTN1O&PSTN1I,DEV=UPDR-98&&-127,MISC1=98,MISC2=0; !PCM 4 SIG.T/S 1!
EXDRI:R=PSTN1O&PSTN1I,DEV=UPDR-129&&-159,MISC1=129,MISC2=0; !PCM 5 NO SIG!
EXDRI:R=PSTN1O&PSTN1I,DEV=UPDR-161&&-191,MISC1=161,MISC2=0; !PCM 6 NO SIG!
EXDRI:R=PSTN1O&PSTN1I,DEV=UPDR-193&&-223,MISC1=193,MISC2=0; !PCM 7 NO SIG!
EXDRI:R=PSTN1O&PSTN1I,DEV=UPDR-225&&-255,MISC1=225,MISC2=0; !PCM 8 NO SIG!

EXDRI:R=PSTN1SO&PSTN1SI,DEV=UPDR-1&-33&-65&-97;           !SIGNALING ROUTES!
```

Figure 3-17: ISUP Routes Definition MSC-S BC (TSC Blades) to the PSTN

When the speech routes are defined, the SI and SP parameters must be used. The SP parameter depends on the destination of the Message Transfer Part (MTP), while the SI parameter is defined as the Permanent Exchange Adaptation and will be found in the Parameter List for the UPLTD function block of the E-module.

Two both-way routes, one for speech and the other for signaling, have been defined towards PSTN.

The network diagram plan shows that eight PCM systems are required to be connected to the route, connecting MSC-S BC and PSTN.

The time slot 1 is reserved/used for signaling, from the first four PCM systems shall be allocated to the signaling route and that time slot 2 to 31 shall be allocated to the speech route. The PCM systems 5 to 8 do not have any time slots allocated to the signaling route yet. Therefore, all 31 time slots will be allocated to the speech routes, making 244 speech circuits in total.

Remember that the timeslots are in fact physically connected in the M-MGW node.

SLS is to be used when sending ISUP messages between the two nodes. It ought to be noted that on this route, time slot 1 in each of the first four PCM systems is used for signaling, four SLCs.

The last EXDRI command allocates the devices of the first four PCM systems to the signaling routes.

Routes Supporting MAP Signaling Protocols

From the network diagram it can be seen that only one signaling route is required to support MAP signaling between MSC-S BC and HLR2. In a real network MAP signaling is used to other nodes like EIR or MSC. A specific signaling route is required here since no other route is available that could carry the MAP message.

Figure below shows the data transcript required for defining the signaling route and the allocation of hardware towards HLR2, which use the High Speed Signaling link (HSL). Make sure that all the circuits are connected to the routes except 0 and 16.

```
!**** ROUTES TOWARDS STAND-ALONE HLR ****!
EXROI: R=HLR2SO&HLR2SI, DETY=UPDR, FNC=7;

!**** H/W ALLOC. FOR ROUTES TOWARDS S.A HLR ****!
EXDRI: R=HLR2SO&HLR2SI, DEV=UPDR-257&&-271&-273&&-287;
```

Figure 3-18: DT for Routes Supporting MAP MSC-S BC (TSC Blades) to the HLR2

Intentionally Blank

4 Signaling over IP in MSC-S BC

Objectives

Setup MSC-S BC based on a network scenario and system documentation.

- Check the defined IP stack on CP.
- Define the signaling transport (SIGTRAN) in an MSC-S blade.
- Set SUA signaling between MSC-S blades.
- Write the exchange data for traffic connections to other MSC-S Blades and other networks by interpreting the Exchange Requirements.
- Create exchange data for the signaling connections towards HLR and other MSC-S Blades and towards other networks by interpreting the Exchange Requirements.

Figure 4-1. Objectives

Intentionally Blank

OVERVIEW

An APZ based node can be configured to support signaling transport over IP network.

In Non-BC system, for example, like APZ 212 40/50, two types of IP stack for APT signaling are supported:

- IP stack on RP (GARP).
- IP stack on CP.

In the MSC-S Blade Cluster system, it includes two APZ systems, Single Sided CP (MSC and TSC Blades) and Dual Sided CP. SPX uses Dual sided CP and blade uses Single Sided CP. IP stack is supported on both SPX and blades.

The main idea here is to show the data transcript of the internal signaling and also the signaling to external nodes.

Signaling in the MSC-S BC uses the feature IP on CP, which is also used by the classical MSC-S. In the MSC-S BC, all the SIGTRAN protocols are supported in the IP stack on CP.

The SIGTRAN feature makes it possible to transport Signaling System No.7 (SS7) signaling traffic (MAP, CAP, INAP, ISUP, BICC, BSSAP and RANAP), and GCP signaling over an IP bearer. The solution is based on the IETF Stream Control Transmission Protocol (SCTP) and the MTP3 User Adaptation Layer (M3UA). With this feature the MSC owns IPv4 interfaces. Thus the MSC can be connected to a pure IPv4 network.

Included in the SIGTRAN feature are also the O&M actions, functions and tasks needed to handle the IP data and addressing, the SCTP Layer and the MTP3 User Adaptation Layer.

OVERALL ARCHITECTURE

This section contains the IP on CP overall structure for MSC-S BC node. The Non-BC node will not be mention any more.

Figure below illustrates the overall structure for APZ based BC node – MSC-S BC.

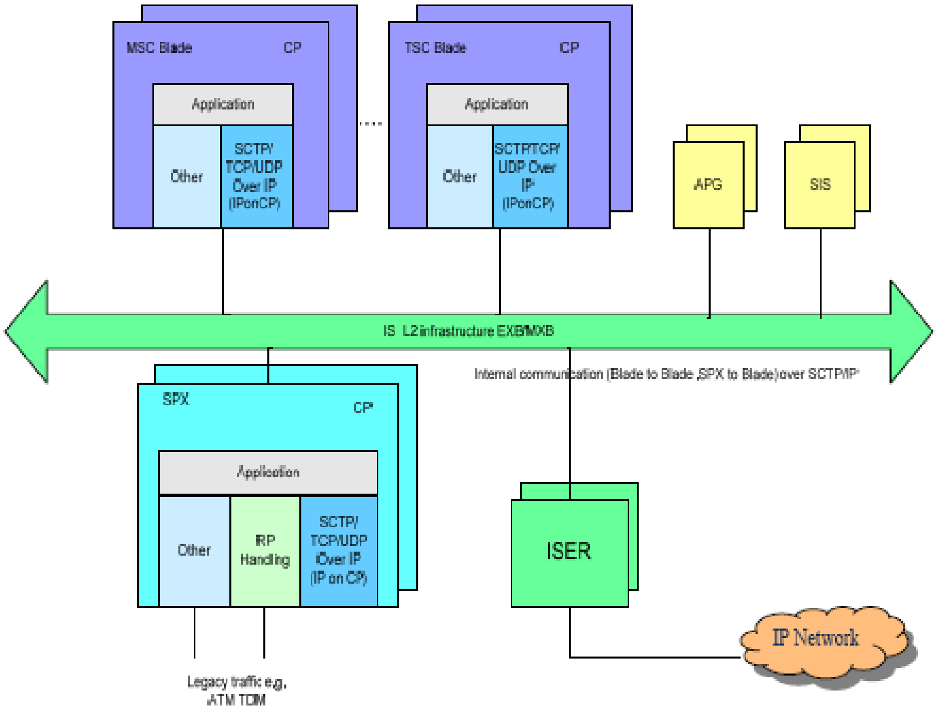


Figure 4-2. IP on CP feature

The BC node uses the IS approach to make use of the already existing network structure on the site.

The IP stack on CP exists in both SPX and blade. TCP, UDP and SCTP are supported.

A pair of ISER is acting as a L3X to provide LAN connectivity to outside IP network. APG and SIS are part of the system for connection to OSS. One of APG acts as single point of entry for all MML commands towards SPX and blade. IP stack is configurable through one of the APG. Statistics and charging are also handled through APG IO system. SIS is mainly for the O&M of the IS infrastructure.

All the traffic is tagged except that APG traffic is untagged Ethernet traffic.

Virtual Interfaces and IP Addresses

A Virtual Interface (VIF) is a logical representation of an interface that is used to send data to or receive data from the connected network. The VIF is connected to a VLAN and all data passing through a VIF belong to the connected VLAN.

IP addresses, routing tables can only be configured on VIFs.

Based on the hardware different types of VIFs are supported:

- **<u>Single Sided CP</u>**: The single sided CP (Blades) supports two physical Ethernet interfaces. These interfaces will appear to the IP stack as a single interface (LAG) because of the Ethernet link aggregation. Virtual interfaces can be configured on top of this single interface A virtual interface defined on a single sided CP is called a 'named VIF' (nVIF). The VLAN name used for nVIF has to be defined as part of the Integrated Site environment (IS) before.
- **<u>Dual Sided CP</u>**: The dual side CP (SPX nodes) supports two physical Ethernet interfaces (ETHA, ETHB). Virtual interfaces can be configured on top of each of the interfaces.

For a dual sided CP the virtual interface name includes the physical interface name (ETHA or ETHB) it is connected to and a number representing the VLAN to be used for this virtual interface, for example:

ETHA-10 is connected to ETHA and uses VLAN 10.

In case two virtual interfaces are defined on the two Ethernet interfaces, and the two virtual interfaces belong to the same VLAN (adjacent interfaces) then the interfaces are called 'virtual interface pair' or VIF-pair.

Specific functions can only be applied on a virtual interface pair, for example the 'Router Supervision' function or the 'IP Address Migration' function.

A virtual interface is always connected to one Ethernet interface (Dual Sided CP) or to the interface of the Ethernet link aggregation (Single Sided CP). On a virtual interface an operator can define Application IP addresses.

Application IP addresses belong to one or more defined IP subnets. A VLAN comprehends one or more IP subnets. For the IP stack on CP, a specific subnet belongs to exact one VLAN.

Router supervision function is available only for a dual sided CP. Each VLAN can have one router supervision instance. Each router supervision instance has 2 router supervision IP addresses, which are used to supervise the IP connectivity between the interface and the supervised gateway in absence of any other IP addresses on the VIF. Router supervision IP addresses and Gateway IP addresses can be defined as part of Router Supervision configuration.

All the IP addresses and VLANs are defined in the startup process and from DT point of view these information are used as given data.

SIGNALING IN THE MSC-S BC

In figure below shows the main signaling transport used internally and externally in the MSC-S Blade Cluster. Note that internally there is a new protocol over SCTP/IP, the SUA – SCCP User Adaptation layer. SUA is used between MSC and TSC Blades and also between Blades and SPX nodes substituting the SCCP. New parameters and concepts appear here and they will be explained further.

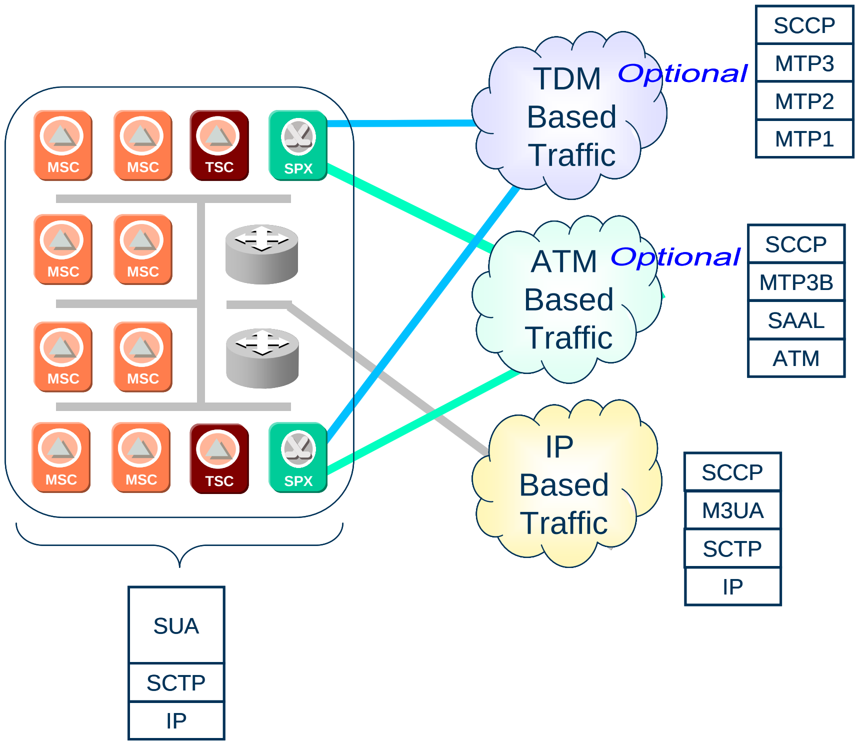


Figure 4-3. SIGTRAN in MSC-S

TDM and ATM signaling transports are also supported in the MSC BC but there required optional hardware as described before.

All the SS7 protocols such as MAP, CAP, INAP, ISUP and others, use SIGTRAN as signaling transport. Note that now, the SIGTRAN protocol stack can vary from M3UA/SCTP/IP and SUA/SCTP/IP. Internally, SCCP protocol is substituted by SUA protocol.

Concepts

The concept supported by this function is IETF SUA concept. The following explain the concepts and used definitions in more details.

This section describes the concept that follows RFC3868 standard.

Application Server (AS): Application Server is a logical entity serving a specified Routing Key in SUA network. The AS contains a set of one or more unique Application Server Processes, of which one or more is processing traffic. Application Server is SCCP User Application which uses SUA and underlying SCTP/IP network as a transport network.

Signalling Gateway (SG): Signalling Gateway is a network element that terminates switched circuit networks and transports SCCP-User signalling over IP to an IP signaling endpoint. A Signalling Gateway could be modelled as one or more Signaling Gateway Process, which is located at the border of the SS7 and IP networks.

Signalling Process (SP): Signalling Process is the process instance that uses SUA protocol to communicate with other signalling processes in SUA network. Each Signaling Process owns an SCTP endpoint, which is used for receiving and sending SUA messages.

In SUA network, Signalling Process can be either Application Server Process (ASP) or Signalling Gateway Process (SGP).

Application Server Process (ASP): Application Server Process is an element of a distributed IP based signalling node. It is provisioned to receive certain ranges of signalling traffic, that is, serve particular ASes.

Signalling Gateway Process (SGP): Signalling Gateway Process is a process instance of a Signalling Gateway.

The function of the SUA Signalling Gateway Process comprises the SCCP layer functions and underlying SS7 stack, and SUA layer functions and underlying SCTP/IP stack.

Routing Key (RK): describes a set of SS7 parameters and/or parameter ranges that uniquely defines the range of signalling traffic configured to be handled by a particular Application Server. Routing Keys are mutually exclusive in the sense that one signalling message cannot match more than one Routing Key within a SUA node, i.e. within an SG or a Signalling Process.

Routing Context (RC): is a value that uniquely identifies a Routing Key at Signalling Gateway Process.

SCTP association: SCTP association is a protocol relationship between SCTP end points. The SCTP transport addresses used by the end points in the association uniquely identify an association. Two SCTP end points must not have more than one SCTP association between them at any given time.

SCTP endpoint: SCTP endpoints are the communicating instances in SCTP. A set of IP addresses and a port number define an SCTP endpoint. The port number is used by SCTP to access the user application of the above layer.

Client - server mode: Client-Server mode applies to SCTP Association establishment / teardown. The node is defined as server in client-server configuration if it receives requests to establish an SCTP association from the client node. Client is the initiator of SCTP association establishment or teardown requests.

Any signalling process may act as a client or server; however it is recommended that ASP is the client and SGP is the server by default.

Socket API: The Socket Application Programming Interface provides a standard design interface across diverse operating systems and multiple platforms.

SUA uses IP stack on the CP, avoiding the need for the GARP boards but allowing the coexistence of both IP stacks within one node.

Stream: A stream is unidirectional logical channel established from one to another associated SCTP End Point, within which all user messages are delivered in sequence, except for those submitted to the unordered delivery service.

Hosted Point Code (HPC): HPC is a new type of SPC in MTP network representing Remote Signaling Point residing in SUA network. In other words, it is a destination that exists in SUA network and it is accessible from external network through the local Signalling Gateways (SGs).

SS7 OVER IP CAPABILITY IN ALL AXE AND CPP NODES

All AXE and CPP nodes are capable of handling SS7 over IP.

In the AXE based nodes, like the MSC/VLR, MSC/MGW, MSC Server, TSC, TSC Server, this is achieved by adding an IP Signaling Terminal HW (SCTP-ST) to the node. The solution is flexible, it allows the operator to add HW to support SS7 over IP gradually as the signaling traffic is moved to IP transport. The upgrade can be done without disturbing the ongoing signaling traffic.

To make the SS7 over IP network complete, other nodes that are vital in the signaling network, like the HLR, AUC, FNR and STP could be upgraded in the same way to enable a complete signaling network to use SS7 over IP. All nodes are capable of having SS7 over IP simultaneously with SS7 over TDM, which means that the migration could be done one step at the time.

The M-MGW is SW upgraded to support SS7 over IP over the existing Ethernet interfaces.

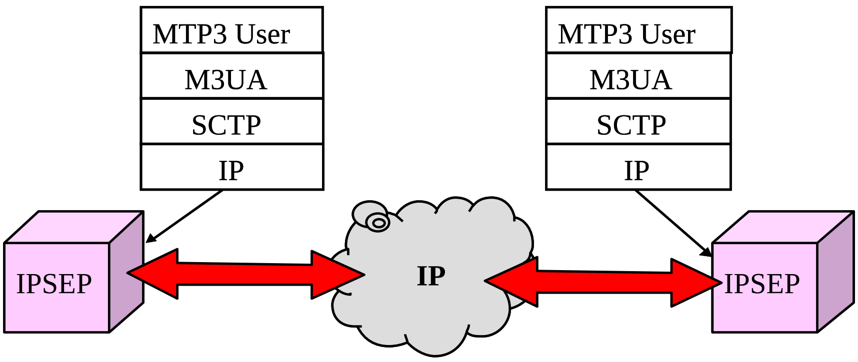


Figure 4-4: MTP Signaling Over IP Protocol View

Shown in the Figure 4-3 is a logical diagram of IP base signaling network with nodes and protocol stack used for signaling over IP. There are some new concepts introduced.

SCTP

SCTP (IETF RFC2960) provides a reliable, connection-oriented bearer service. The connection between two nodes is called an SCTP association and can consist of multiple paths through an IP network. Multiple paths are based on the multi-homing feature, which allows each SCTP end point to use multiple IP addresses for each association. One of the paths is used as the primary communication channel. If the primary path becomes unavailable, one of the other available paths is used. Availability of paths is monitored using a heartbeat mechanism. An association can support multiple streams. A stream can be seen as an independent communication channel in the sense that a retransmission on one stream doesn't stop or slow down the traffic in another stream. Within a stream, the order of transmitted messages can be guaranteed.

M3UA

The MTP3 User Adaptation Layer (M3UA) function defines a protocol for supporting the transport of any SS7 MTP3 user signaling (for example, ISUP and SCCP messages) over IP using the Stream Control Transmission Protocol (SCTP) services. It also may provide gateway functionality that enables seamless operation of MTP3 user peers in the SS7 and IP domains.

There are two kinds of nodes which use M3UA to be considered: IP Signaling End Points (IPSEPs) and Signaling Gateways (SGWs).

A node which is configured to be an IPSEP is able to handle originating and terminating traffic in the IP network as well as in the SS7 network. An IPSEP includes all functionality that is available within an SEP

A node which is configured to be an SGW is able to handle originating and terminating traffic in the IP and SS7 networks, as well as transfer (SS7 <-> SS7) and gateway (SS7 <-> IP) traffic at M3UA level. The specific functionality available within an SGW is described in reference.

M3UA consists of the following functions:

- M3UA Signaling Message Handling.

This function handles the routing of signaling messages to IP through the suitable SCTP association and stream, and the distribution of received messages from IP within the local exchange.

- M3UA Routing

This is used at each SP to determine the outgoing SCTP association and stream through which a message is to be sent towards its destination through IP.

- M3UA Discrimination

This is used at each SP to determine whether or not a message received from IP is destined to the SP itself. In the IPSEP nodes the messages not destined to the OWNSP are discarded.

- M3UA Distribution

This is used at each SP to deliver the messages received from IP (destined to the SP itself) to the appropriate MTP3 user or to the Signaling Network Management part of M3UA.

Two types of traffic are handled in an IPSEP:

Incoming

When a message is received from an SCTP association in an IPSEP, it is decided whether it is to be terminated or to be discarded. If the message is to be terminated and is a Transfer (DATA) message, it is distributed to the indicated MTP3 user. If the message is a Management (MGMT), SS7 Network Management (SSNM), ASP State Management (ASPSM) or ASP Traffic Maintenance (ASPTM) message, it is distributed within the M3UA.

Outgoing

When a message is sent from an MTP3 user through IP, the SCTP association and outbound stream predetermined to transfer the message to the indicated destination are selected. The message is then sent on this SCTP association and stream.

- M3UA Signaling Network Management.

It is divided into three sub-functions as follows:

– M3UA Signaling Traffic Management is in charge of diverting traffic to alternative IP signaling routes in case of IP signaling route failure and of controlling traffic when congestion occurs at a signaling point in the IP network. It is also in charge of restarting a signaling point and of slowing down traffic when congestion occurs towards a signaling point.

– M3UA Signaling Route Management distributes information about the IP signaling network status.

– M3UA Association Management defines, establishes and activates idle SCTP associations, and deactivates and terminates SCTP associations.

TRAFFIC CASES

Here give an example of transfer traffic shown in Figure 4-4. Transfer traffic from IP network consists of messages received from the IP network which is designated for a destination signaling point other than the own signaling point. Transfer traffic is received and discriminated from terminating traffic, thus, if the destination of a message is not the own signaling point, the message does not terminate at this node and it should be transferred towards the appropriate destination.

The next step will be to check whether the own IP signaling node is an IPSEP or a SGW:

- **IPSEP**

If the own IP signaling node is an IPSEP the transfer traffic will not be processed (only terminating traffic is handled in an IPSEP).

- **SGW**

However, if the own IP signaling node is a SGW (terminating and transfer traffic are handled in a SGW), the message has to be routed towards the appropriate destination.

The SGW will then make the protocol transfer from IP to other protocols used by connected network (e.g. C7/ATM or STM). Shown as Figure below.

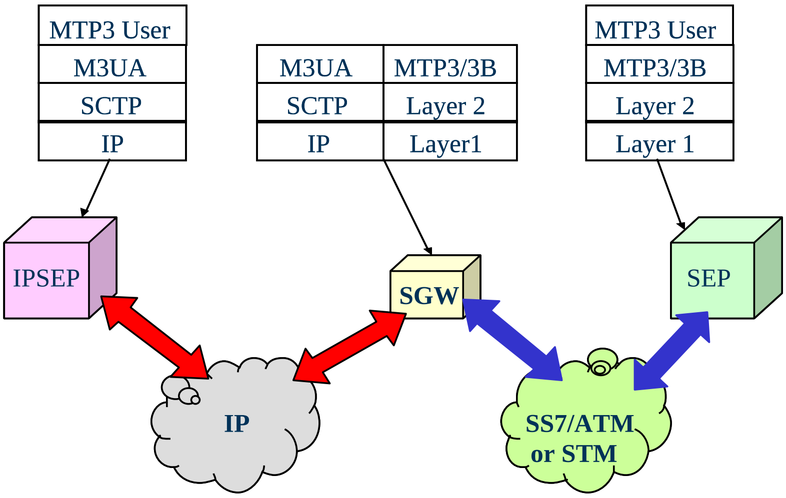


Figure 4-5: Protocol View for Transfer Traffic

NETWORK CONFIGURATION EXAMPLE

Considering the scenarios where external SS7 SEPs have access to SUA Application Servers via single or multiple SUA SGs, two network configurations are supported.

As MSC-S BC there are always two SPX nodes acting as SGs, so only the Multiple SG Configuration is shown:

Multiple SG Configuration

External SS7 nodes using the Multiple SG configuration mode sees ASPs as one SS7 node connected to them via two STPs. In this case the SUA SGs act as MTP3 STPs towards the external nodes.

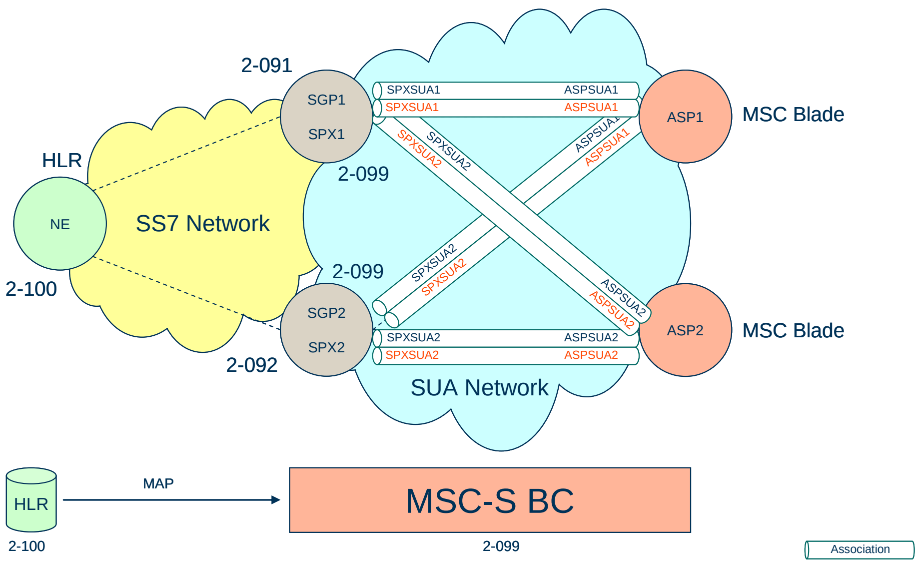


Figure 4-6. Multiple SG Configuration example

Each ASP (represents the MSC Blades) is connected over predefined transport (one association) with specific SGP (represents the SPX node).

The SG contains only one SGP. Each SGP manages specific AS over one or number of defined.

In the figure above the ASP represents the MSC Blades (we do not define SUA signaling for TSC Blades), the SGP represents the SPX nodes and NE any node in the SS7 network, such as HLR, BSC, RNC, SMS-C and so on.

SIGTRAN definition between MSC Blades and SPX nodes are done using the VLAN 1001, as stated before. The IP addresses used so is the ones configured in the VLAN 1001 which is possible to check by sending the command IHIFP in each node and blades.

Internal signaling transport is done in the startup or implementation phase.

Assuming that all the physical IP backbone and SIGTRAN are already done, SUA part should be defined as follow:

Configuration in SGP

SGP configuration described in this chapter is valid for AS defined in Multiple SG configuration.

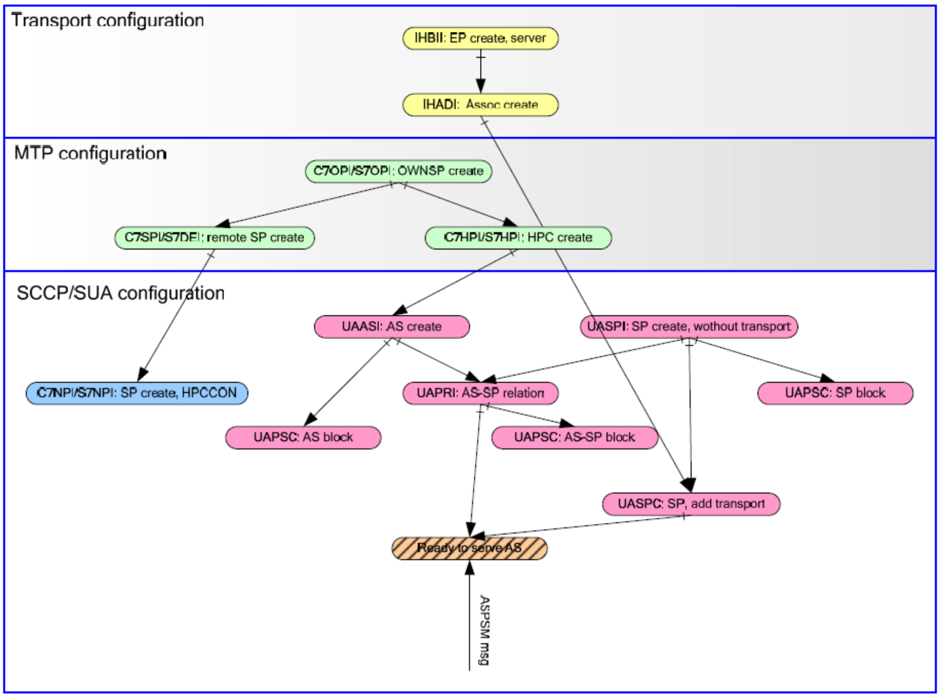


Figure 4-7. Configuration in SGP, Multiple SG scenario

Configuration of MTP Layer

Own SPC Definition

Each node in SS7 network is identified by means of an SPC.

```
C7OPI:OWNSP=2-091, SPTYPE=SGW;
```

```
C7OPI:OWNSP=2-092, SPTYPE=SGW;
```

Own SPC is defined by means of C7OPI command for ITU, MPT and TTC networks and S7OPI for ANSI networks.

HPC Definition

The HPC is a new type of SPC in MTP network. The HPC definition is only possible if SPXFUNCTION feature is available.

```
DBTRI;
```

```
DBTSC:TAB=AXEPARS, SETNAME=SIGIPS, NAME=SPXFUNCTION, VALUE=1;
```

```
DBTRE:COM;
```

The HPC definition is mandatory for any SGP configuration valid for AS defined in Multiple SG configuration.

HPC is defined by means of C7HPI command for ITU, MPT and TTC networks and S7HPI for ANSI networks. For MSC-S BC R13.1 only ITU-T standard is supported.

For the example case the point codes 2-091 on SPX1 and 2-092 on SPX2 are defined as SGW. Furthermore the common MSC Point Code 2-099 must be defined as HPC. From the HLR point of view it sees the MSC-S BC as single point code, i.e. the SP=2-099:

```
C7HPI:HPC=2-099;
```

Destination SPC Definition

Definition of destination SPCs for ITU, MPT and TTC networks is performed using the command C7SPI.

Now, the SPX should knows the HLR signaling point code:

```
C7SPI:SP=2-100;
```

```
C7PNC:SP=2-100, SPID=HLR100;
```

Configuration of SCCP Layer

For configuration of SCCP layer on SG the existing SCCP commands must be used. Here, only the specific SCCP/SUA configuration differences comparing to existing SCCP command is highlighted.

Although the configuration of SCCP layer is independent from configuration of SUA layer, prerequisite for configuration of SCCP layer is configuration of MTP layer.

Considering the scenarios where external SS7 SEPs have access to SUA Application Servers via Multiple SG, the remote SCCP Network Signalling Point (representing the external SS7 elements from the SG perspective) must be defined by means of command C7NPI and C7NPC for ITU, MPT and TTC networks and S7NPI and S7NPC for ANSI networks. In Multiple SG scenario HPCCON parameter must be set. Note that when HPCCON parameter is set on SGP, it is not possible to define any SSN.

In order to indicate to the SCCP layer that the remote peer operates to the MSC Server Blade Cluster via Multiple SGs (two SPXes, Multiple SG scenario) the following must be defined:

```
C7NPI:SP=2-100,HPCCON;
```

In the SPX nodes, this is the destination signaling point that will the converted from SUA to SCCP protocol.

- Own SPC Definition:
  C7OPI:OWNSP=2-091, SPTYPE=SGW; !SPX1!
  C7OPI:OWNSP=2-092, SPTYPE=SGW; !SPX2!

- Hosted Signaling Point:
  C7HPI:HPC=2-099; !HLR sees HPC as a unique point code from MSC-S BC!

- Destination Point Code: HLR node.
  C7SPI:SP=2-100;
  C7PNC:SP=2-100, SPID=HLR100;

- Destination Point Code (HLR) in the SCCP level:
  C7NPI:SP=2-100,HPCCON;

Figure 4-8: SS7 Signaling Definition SPX Nodes

Configuration of SCTP Layer

This section describes only the mandatory steps in SCTP layer configuration which must be done as prerequisites to SUA layer configuration.

Note that SUA is user of new Socket API based SCTP.

SCTP End point Initialization

SUA layer binds as a user to the SCTP layer, creating a new SCTP end point by means of command IHBII.

The parameters provided by the command are an SCTP end point identity, up to four local IP addresses, a local port number as an optional parameter, and indication that the traffic will be distributed to SCTP on CP.

Prerequisite for command IHBII is to have local IP address (es) defined on IP level.

The same local IP address set can be used by various SCTP end points as long as different local SCTP port numbers are provided in the command. If not provided, value 14001, representing the port number allocated for SUA (well known port), for the local port number is used.

The SERVER mode should be used for associations towards SUA nodes defined as pure clients for achieving better interoperability.

Follow the commands sent in the SPX nodes:

```
IHBII:LIP=   "192.168.1.201"&"192.168.1.202",
EPID=SUASEP01,   USER=SUA,   MODE=   SERVER,
SCTPCP;
```

SCTPCP parameter indicates that is defining the EPID for IP on CP. User parameter indicates the protocol that will use the EPID.

SCTP Association Data Definition

Once an SCTP End Point is created, one or several SCTP Associations can be defined. Command IHADI is used for that purpose.

The mandatory parameters provided by the command are an SCTP association identity, an SCTP end point and up to four remote IP addresses.

The optional parameters are a remote port number and a number of outbound streams for outgoing traffic through the association.

When an SCTP association is defined in SERVER mode, only the IP address of the remote must be provided in the command, omitting the remote port number. The remote client typically uses use ephemeral ports, so that the remote port number is not known.

The first given remote IP address in the command will be the first IP address to which association establishment is initiated.

```
IHADI:SAID=SPXSUA1,              EPID=SUASEP01,
RIP="192.168.1.103", SCTPCP;
```

- **SCTP End point Initialization**

  IHBII:LIP= “192.168.1.201” & “192.168.1.202”, EPID=SUASEP01, USER=SUA, MODE= SERVER, SCTPCP;

- **SCTP Association Data Definition**

  IHADI:SAID=SPX1SUA, EPID=SUASEP01, RIP=“192.168.1.103”, SCTPCP;

Figure 4-9: Signaling Transport SPX Nodes

Configuration of SUA Layer

Configuration of SUA layer is valid for ITU, MPT, TTC and ANSI networks.

AS Definition:

Application Server is uniquely identified by Routing Key. The AS must be defined for specific local Signaling Process behaviour.

Application Server is defined by means of command UAASI and UAASC.

Some of parameters in UAASI command are: AS local identifier (ASID) , protocol type (PROT), Signaling Process type (SPTYPE), Destination Point Code (DPC) related to Routing Key uniquely applied to AS being defined, Network Indicator (NI) and Routing Context (RC).

All parameters are valid for ITU, MPT, TTC and ANSI networks except NI which is not valid for ANSI network.

Each DPC defined within AS defined in Multiple SG configuration has to be defined first on MTP level as HPC.

The RC is mandatory data in UAASI command. This is because looking from SGP AS must have unique RC value.

The SINGLESG parameter must not be used in any AS defined for SGP.

On each SPX the following AS shall be defined for the example case.

```
UAASI:ASID=AS2099, SPTYPE=SGP, DPC=99, NI=2,
PROT=SUA, RC=2099;
```

Please note that it is possible to define more then one DPC to an Application server (UAASC).

Definition of SSN related to AS:

This step is omitted for AS defined in Multiple SG configuration.

Remote Signaling Process Definition:

Remote Signaling Process represents remote SUA peer to which local process will be connected for specific AS. Remote Signaling Process is defined by means of command UASPI.

The parameters in command are: Signaling Process identifier (SPID), protocol type (PROT), Signaling Process type (SPTYPE) and optionally SCTP association (SAID) used for transport connection to that remote Signaling Process.

Note that meaning of Signaling Process type parameter in UASPI command has opposite meaning than in UAASI command, because in UAASI command, SPTYPE describes local behavior of defined AS.

As described above, SAID parameter is optional in command UASPI. This is in order to be able to configure SUA application, independently of configured transport. Transport can be applied in the end, using command UASPC. Only one SAID can be applied for specified SP. Application Server Processes has to be established on each SPX to each MSC blade:

```
UASPI:SPID=BLD2, SPTYPE=ASP, PROT=SUA;

UASPI:SPID=BLD3, SPTYPE=ASP, PROT=SUA;

...

UASPI:SPID=BLD17, SPTYPE=ASP, PROT=SUA;

UASPC:SPID=BLD2, PROT=SUA, SAID=SUAMSC1;
```



```
UASPC:SPID=BLD3, PROT=SUA, SAID=SUAMSC2;
```

...

```
UASPC:SPID=BLD17,PROT=SUA,SAID=SUAMSC15;
```

Signaling Process Relation Definition:

Once AS with its Routing Key and remote Signaling Process are defined, the remote Signaling Process relation with AS must be initiated. The type of AS and the type of remote Signaling Process must be forming a valid pair (SGP-ASP).

One remote Signaling Process can be assigned to more than one AS.

The remote Signaling Process relation with AS is initiated by means of command UAPRI.

The parameters in command are: Signaling Process identifier, protocol type, AS local identifier, and optionally Routing Context. Routing Context is assigned for local ASP types only. For local SGP, Routing Context as a unique identifier is defined in command UAASI.

```
UAPRI:SPID=BLD2,ASID=AS2099,PROT=SUA;

UAPRI:SPID=BLD3,ASID=AS2099,PROT=SUA;
```

...

```
UAPRI:SPID=BLD17,ASID=AS2099,PROT=SUA;
```

- **AS Definition:**
  UAASI:ASID=AS2099, SPTYPE=SGP, DPC=99, NI=2, PROT=SUA, RC=2099;
- **Remote Signaling Process Definition:**
  UASPI:SPID=BLD2, SPTYPE=ASP, PROT=SUA;
  …
  UASPI:SPID=BLD17, SPTYPE=ASP, PROT=SUA;

  UASPC:SPID=BLD2, PROT=SUA, SAID=SUAMSC1;
  …
  UASPC:SPID=BLD17,PROT=SUA,SAID=SUAMSC15;
- **Signaling Process Relation Definition:**
  UAPRI:SPID=BLD2,ASID=AS2099,PROT=SUA;
  …
  UAPRI:SPID=BLD17,ASID=AS2099,PROT=SUA;

Figure 4-10: SUA Definition SPX Nodes

Configuration in ASP

This section describes SUA configuration in ASP, i.e. in the MSC Blades. TSC Blades use SUA as well but it is not defined by the operator.

Configuration of SUA in ASP is valid for ITU, MPT, TTC and ANSI networks.

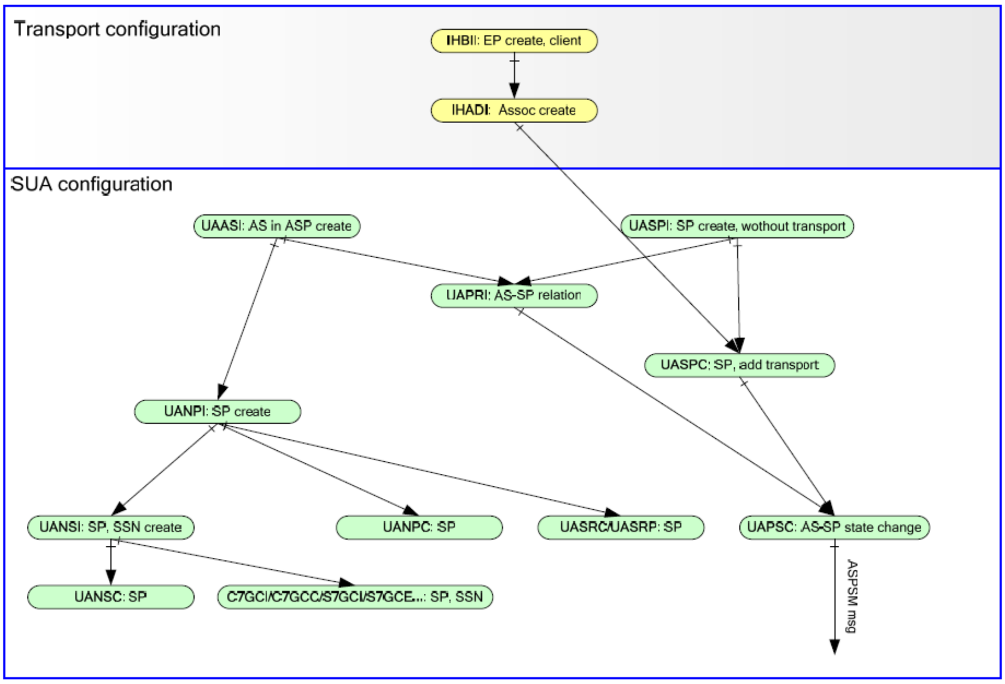


Figure 4-11. Configuration in ASP

The following tasks must be performed to configure SUA layer:

AS definition:

The RC must not be used in UAASI command.

SINGLESG parameter must not be used for AS defined in Multiple SG.

On each MSC blade the following AS shall be defined for the example case.

```
UAASI:ASID=AS2099, SPTYPE=ASP, DPC=99, NI=2,
PROT=SUA;
```

SPC Definition for Remote Destination in SUA Network:

A remote destination which can only be reachable via SUA network must be defined in ASP.

A definition of SUA NE SPC for ITU, MPT and TTC and ANSI SUA networks is performed using the command UANPI. This is how the MSC Blades know the “destination signaling point” in SUA network.

The parameters in command are: Signaling Point and Application Server Signaling Point. Both parameters are mandatory since they form a valid [Remote DPC, OPC] pair.

For the example case following remote destination is defined on each MSC blade:

```
UANPI:SP=2-100, ASSP=2-099;
```

Note that specific remote destination in SUA network is allowed to be defined over one Application Server in specific ASP. The same remote destination in SUA network over another Application Server in the same ASP is not allowed to be defined. The same remote destination in SUA network can be only defined in other ASP over the same or different Application Server.

Definition of Network Subsystem (SSN) Related to Remote Destination in SUA:

For example, the following shall be defined on all MSC blades.

```
UANSI:SP=2-100,SSN=6;
```

Global Title Translation Tables Definition:

The definition of GTT tables in ASP (it is optional) is still done by existing SCCP commands. No differences in configuration considering the specific SUA configuration exist.

For more details on Global Title Translation tables handling (GTT) see the relevant SCCP OPI documents.

Remote Signaling Process Definition:

Remote Signaling Process represents remote SUA peer to which local process will be connected for specific AS. Remote Signaling Process is defined by means of command UASPI.

The command UASPI is mandatory in ASP.

The parameters in command are: Signaling Process identifier, protocol type, Signaling Process type, Signaling Gateway identifier and optionally SCTP association used for transport connection to that remote Signaling Process.

Note that meaning of Signaling Process type parameter in UASPI command has opposite meaning than in UAASI command, because in UAASI command, SPTYPE describes local behaviour of defined AS.

As described above, SAID parameter is optional in command UASPI. This is in order to be able to configure SUA application, independently of configured transport. Transport can be applied in the end, using command UASPC. Only one SAID can be applied for specified SP. In the example case SAID parameter is added later using UASPC command:

```
UASPI:SPID=SPX1, SPTYPE=SGP, PROT=SUA, SGID=SPX1;

UASPI:SPID=SPX2, SPTYPE=SGP, PROT=SUA, SGID=SPX2;

UASPC:SPID=SPX1, SAID=SPXSUA1;

UASPC:SPID=SPX2, SAID=SUASPX2;
```

The UASPI command represents the SPXes in the MSC blades. Once the SPXes are defined in the MSC Blades, there is no need to define the them later on and they will be used further for the other definitions as well.

Signaling Process Relation Definition:

Once AS with its Routing Key and remote Signaling Process are defined, the remote Signaling Process relation with AS must be initiated. The type of AS and the type of remote Signaling Process must form a valid pair (ASP-SGP).

One remote Signaling Process can be assigned to more than one AS.

The remote Signaling Process relation with AS is initiated by means of command UAPRI.

The command UAPRI is mandatory in ASP.

The parameters in command are: Signaling Process identifier, protocol type, AS local identifier and Routing Context.

```
UAPRI:SPID=SPX1, ASID=AS2099, PROT=SUA, RC=2099;

UAPRI:SPID=SPX2, ASID=AS2099, PROT=SUA, RC=2099;
```

- **SCTP End point Initialization**
  IHBII:LIP= “192.168.1.103”, EPID=SUASEP01, USER=SUA, MODE=CLIENT, SCTPCP;

- **SCTP Association Data Definition**
  IHADI:SAID=ASPSUA1, EPID=SUASEP01, RIP=“192.168.1.201” & “192.168.1.202”, SCTPCP;

Figure 4-12: Signaling Transport MSC Blades

- **AS definition:**
  UAASI:ASID=AS2099, SPTYPE=ASP, DPC=99, NI=2, PROT=SUA;

- **SPC Definition for Remote Destination in SUA Network:**
  UANPI:SP=2-100, ASSP=2-099;

- **Definition of Network Subsystem (SSN) Related to Remote Destination in SUA:**
  UANSI:SP=2-100,SSN=6;

- **Remote Signaling Process Definition:**
  UASPI:SPID=SPX1, SPTYPE=SGP, PROT=SUA, SGID=SPX1;
  UASPI:SPID=SPX2, SPTYPE=SGP, PROT=SUA, SGID=SPX2;
  UASPC:SPID=SPX1, SAID=SPXSUA1;
  UASPC:SPID=SPX2, SAID=SUASPX2;

- **Signaling Process Relation Definition:**
  UAPRI:SPID=SPX1, ASID=AS2099, PROT=SUA, RC=2099;
  UAPRI:SPID=SPX2, ASID=AS2099, PROT=SUA, RC=2099;

Figure 4-13: SUA Definition MSC Blades

The relation between ASP and SGP in SG and AS nodes behavior is show below:

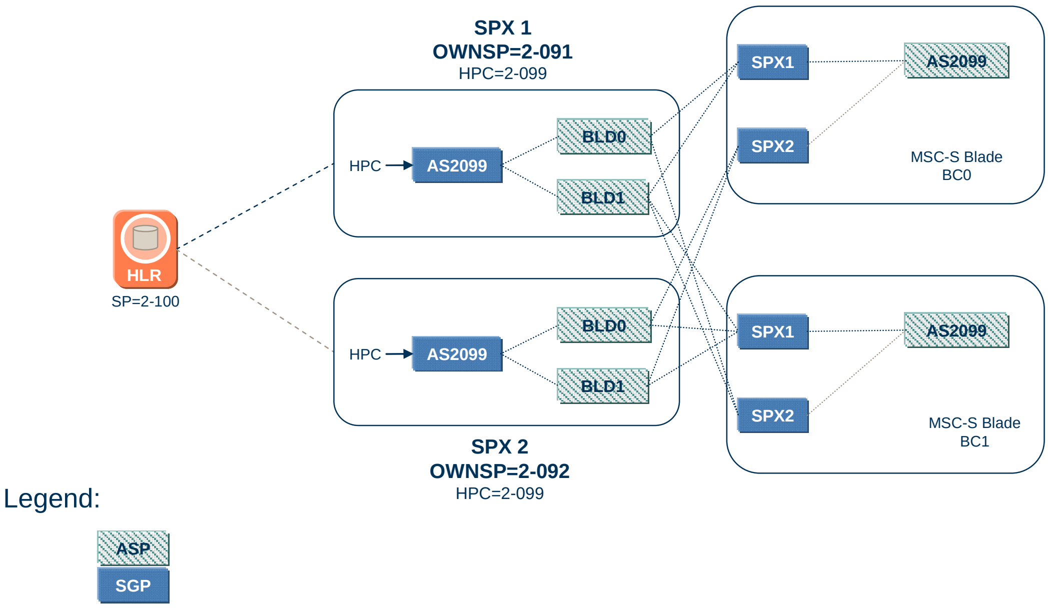


Figure 4-14. Summary relation between SGP and ASP

GCP OVER SCTP

Since MSS R5.0 GCP can be implemented over SCTP directly. This conforms to the 3GPP specifications requiring GCP/SCTP for pure IP networks, while opening up the option of using M3UA in mixed ATM/IP networks. For an Ericsson MSC-S to interoperate with multi-vender M-MGWs it is necessary for GCP to be transported over SCTP.

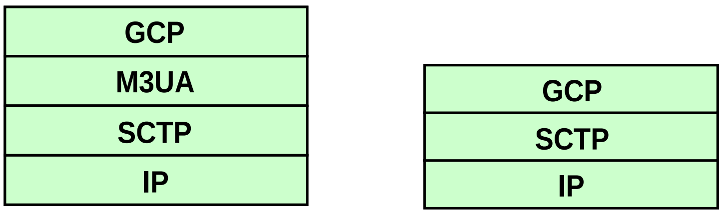
There are no different protocol variants (ITU-T, ANSI, MPT, TTC) as far as GCP, SCTP and IP are concerned.

As a means to transfer GCP protocol directly over SCTP, STC (Signaling Transport Converter) is used.

The STC entity is not visible in the network, i.e. it has no peer end to communicate with, but it helps signaling applications to stay independent on a transport level technology utilized between the network's nodes.

The MSC-S BC node can handle GCP/SCTP/IP and GCP/M3UA/SCTP/IP stacks at the same time, as long as they are used towards different virtual M-MGWs.

The following figure shows protocol stacks seen through the messages exchanged in the network (i.e. no STC in peer to peer communication is visible):



Note: In this case the blades use the External VLANs (2001 and 2002) IP Addresses.

Figure 4-15: GCP over SCTP MSC and TSC Blades

The GCP Transport over SCTP feature provides a GCP transport service that is based on end-to-end SCTP associations between an MSC Server and an M-MGW. The SCTP multi-homing mechanism provides reliability in the form of multiple paths that are established through the IP backbone.

In networks, where Signaling Gateways are used MSC Server and the M-MGW, the M3UA layer is needed to handle the inter-working towards MTP3b. In a full IP environment, the M3UA layer adds no value and can therefore be omitted.

DATA TRANSCRIPT FOR GCP OVER SCTP

The M-MGW is defined only in the MSC and TSC Blades. In this case the GCP signaling pass directly to the ISER (IS Router) and not through SPX nodes. No M3UA routing is needed.

- **SCTP End Point Initialization:**
  IHBII:LIP="10.2.111.3"& "10.2.111.67",EPID=EMGW1, USER=GCP, SCTPCP, MODE=SERVER,LPN=2945;

  LPN: local port number for GCP over SCTP, if not given = 2945 for binary encoding, when user=GCP

- **SCTP Association Data Definition:**
  IHADI:SAID=BLD1MGW1,EPID=EMGW1, RIP="10.3.9.20"& "10.3.9.148", SCTPCP;

  OS (Outbound Streams): Not to be more than 16 for GCP over SCTP.
  Mode: server/peer, when GCP is the EP user, default for MSC-S is server MODE and peer is not allowed.

  Command IHASC:SAID=said,proc=estb; IS NOT USED for GCP over SCTP.

Figure 4-16: Data Transcript for GCP over SCTP MSC and TSC Blades

- **M-MGW Definition using GCPoSCTP:**
  NRGWI:MG=CMGW6, BCUID=2610, SIGTR=SCTP, SIGADDR=BLD1MGW1;

Figure 4-17: M-MGW Definition MSC and TSC Blades

5 MSC-S BC Features

Objectives

List the most common features in Mobile Softswitch Solution R5.2 accordingly to system documentation.

- List the new sets of data necessary to define the Call Set up in the MSS architecture for MSC-S and Media Gateway.
- Write the exchange data for M-MGW definition in MSC-S BC.
- Define remote TDM devices, MGW selection, BICC and GCP data in the MSC-Server BC.
- Illustrate the MML required for basic traffic case using TFO, TrFO and Codec at the Edge.
- Write the MML required in the MSC-S BC to implement the MSC-S BC in Pool.

Figure 5-1. Objectives

Intentionally Blank

MOBILE SOFTSWITCH SOLUTION

The layered architecture as described by 3GPP R6 changes the current vertically specialized network (where different applications have their own access, transport, and control nodes for traffic handling) into a horizontally layered structure. This layering means in practice that the different levels in network hierarchy are separated, and communicate over well-specified interfaces. Thus different applications can share the resources in the lower levels of the network.

The layered architecture is implemented by Ericsson as the Mobile Softswitch Solution (MSS) in the Mobile Network. The MSS presents a seamless network to the user by the merger of GSM and WCDMA networks, this enables the operator to offer quality services for voice, data and multimedia in the most cost-effective and resource efficient way. The seamless network solution is composed of multimode handsets that work both GSM and WCDMA frequencies and a network that combines the GSM and WCDMA resources like the common connectivity layer. The MSS comprises of two nodes the MSC-Server on the Control layer and the M-MGW on the connectivity layer.

The MSS R5.2 uses the MSC-S Blade Cluster R13.1.

Ericsson MSC-S Blade Cluster is a state of the art processor system for MSC Server. It features a multi processor using blade technology, which provides very high capacity, scalability and outstanding node availability. MSC Server Blade Cluster scales easily to very high capacity nodes while at the same time significantly increasing the node resilience. This is allows for an impressive network simplification and creating a network infrastructure that is easy to manage, always available and capable of adjusting to unpredictable future traffic increases and changing business needs.

MSC Server Blade Cluster is an evolution of the successful MSS software being made available on state of the art generic single-sided processor blades that are grouped into a cluster. The cluster infrastructure is provided by utilizing the components of Ericsson’s Integrated Site Infrastructure.

The MSC Server is available on Blade Cluster state-of-the-art, modern HW architecture. MSC server processor blades are provided for traffic handling and signaling proxy (SPX) for handling the interface towards external network. MSC server blades form a multi processor cluster. The MSC Server Blade Cluster is implemented using the cluster concept and the Integrated Site (IS) infrastructure which allows co-location with IMS and other TSP based applications in the same node.

The benefits achieved with the blade cluster based MSC Server system are coming from the clustering of processor blades and from using the Integrated Site infrastructure. MSC Server Blade Cluster is a multi processor system containing a signaling proxy and several processor blades and an I/O system.

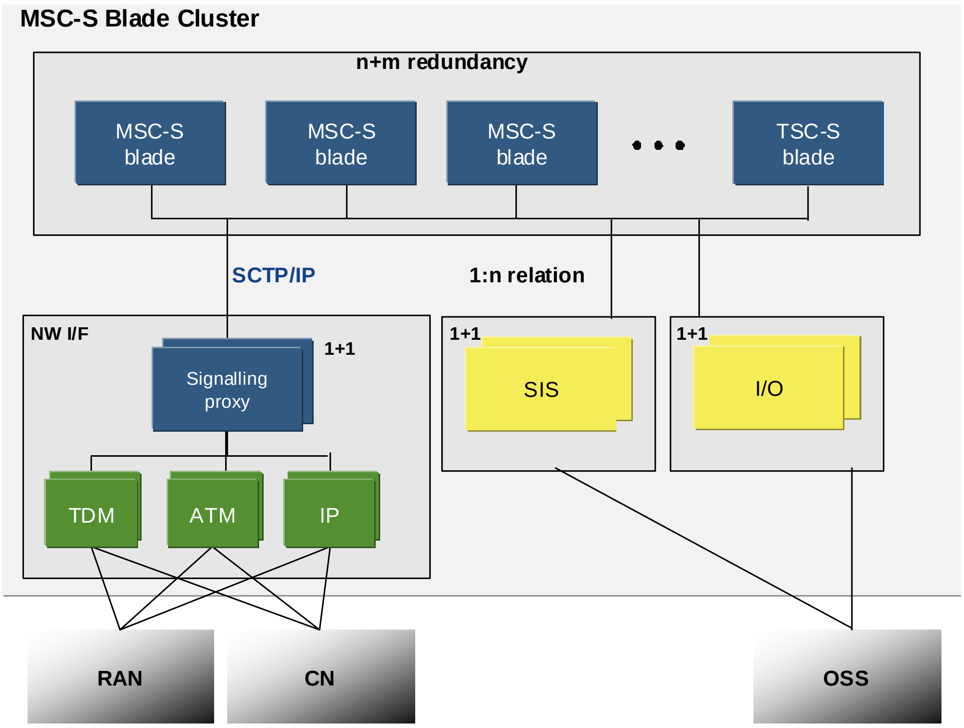


Figure 5-2. MSC Server Blade Cluster architecture

The processor blades within an MSC Server form a blade cluster using single-sided AXE CP processors. There are two different kinds of blades, MSC blades handling the traffic and TSC blades handling the connections towards other the core network nodes and networks.

The MSC blades share the load of the MSC Server Blade Cluster i.e. distributes the subscribers over all MSC blades within the cluster. Distribution happens at initial location updating. The criteria to distribute the subscribers are the IMSI or IMEI of the subscriber and the capacity defined by load vector per each MSC blade. Each subscriber registered in the VLR is replicated over two different MSC blades (primary and secondary blade) for resilience.

The TSC blades are provided for the connections towards the other core network nodes and other networks using ISUP, BICC or SIP. These blades do not hold any subscribers.

The Signaling Proxy in the cluster is used as an aggregation node for C7 interfaces towards a broadband IP/SCTP interface. Signaling proxy converts and routes signaling traffic received from external network nodes to the MSC Server Blade Cluster. Signaling Proxy hides the blade cluster concept from the external network point of view. Signaling proxy will distribute the new subscribers round-robin between MSC blades which will then further distribute the subscribers to the primary blade and secondary blade. Always two signaling proxies per MSC Server Blade Cluster are included in order to facilitate the n + m redundancy.

Redundancy and resilience of MSC Server blades is achieved by means of an “n + m” model which means that if a single processor blade fails the blades remaining in service take over the traffic. Each subscriber is assigned a blade pair, namely primary and secondary blade in which the subscriber data is stored. All traffic is directed to primary blade in the first place. In case primary blade is not available (planned or un-planned), traffic will be handled by the subscriber’s secondary blade. This kind of resilience is achieved by subscriber VLR data replication mechanism, which makes sure that semi-static and dynamic data pertaining to a certain mobile subscriber is available always in two blades. Due to this mechanism it is possible to isolate a blade from traffic, perform an upgrade or update and open the blade again for traffic without any traffic disturbance.

In case one blade fails completely the self healing process will re-distribute the subscribers between remaining blades.

Redundancy summary of the different components

- SPX, 1+1 node protected, plus 1+1 network protected
- MSC blades, n+1 protection
- TSC blades, 1+1 protection on network level
- APG 43, 1+1 node protection

- SIS, 1+1 node protection

The MSC Server Blade Cluster is well suited to manage capacity since processor blades can be added to the cluster when more capacity is needed and during a live operation.

As well as MSC Server Blade Cluster can be used as an extension to already installed servers or as a member of MSC pool in network.

MSC Server Blade Cluster is implemented in the same, common application SW (dump) as the classical MSC Server. Therefore MSC Server Blade Cluster is using same O&M procedures as classical MSC server.

I/O system is APG43. Separate I/O systems can be used for MML commands for blades, charging and statistics.

MSS CORE NETWORK OVERVIEW

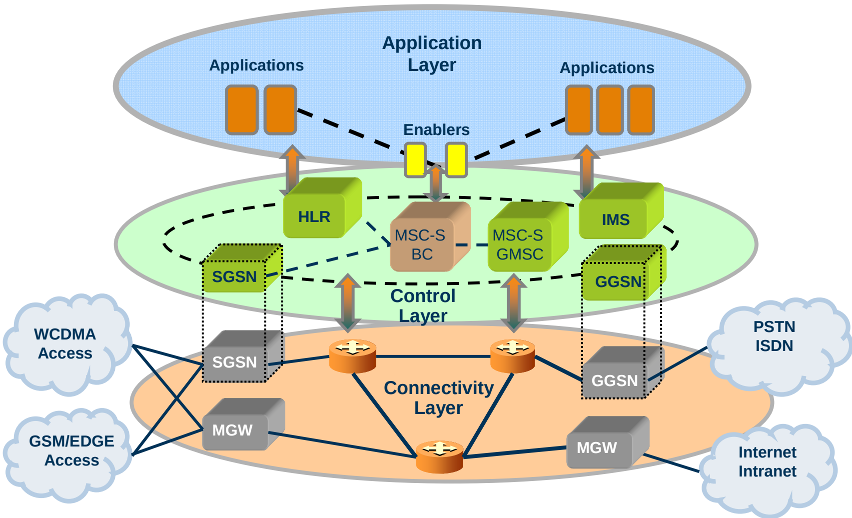


Figure 5-3: Core Network Overview

The M-MGW connects the Mobile Core Network with external networks such as WCDMA and GSM Radio Access Networks, PSTN Networks or other Mobile Networks. With M-MGW, the layered network architecture can be fully implemented for circuit-switched traffic. MSC Servers remotely control the M-MGW using the Gateway Control Protocol (GCP) that is based on the ITU-T H.248 standard. The M-MGW makes IP, ATM and TDM transport possible in the backbone network for both the circuit-switched payload traffic as well as for the signaling. For WCDMA packet-switched traffic the M-MGW cross-connects the ATM-based user and control traffic to the SGSN node.

In addition to providing inter-working between different transport technologies, the M-MGW also provides advanced speech and data processing capabilities.

SYSTEM OVERVIEW

The M-MGW consists of the Media Gateway Application and Signaling Gateway Application built on top of the Ericsson Connectivity Packet Platform (CPP).

Media Gateway Application

The Media Gateway application consists mainly of the functions related to communication with the MSC/TSC Server(s), processing of the payload and inter-working between different transport technologies on Connectivity Layer.

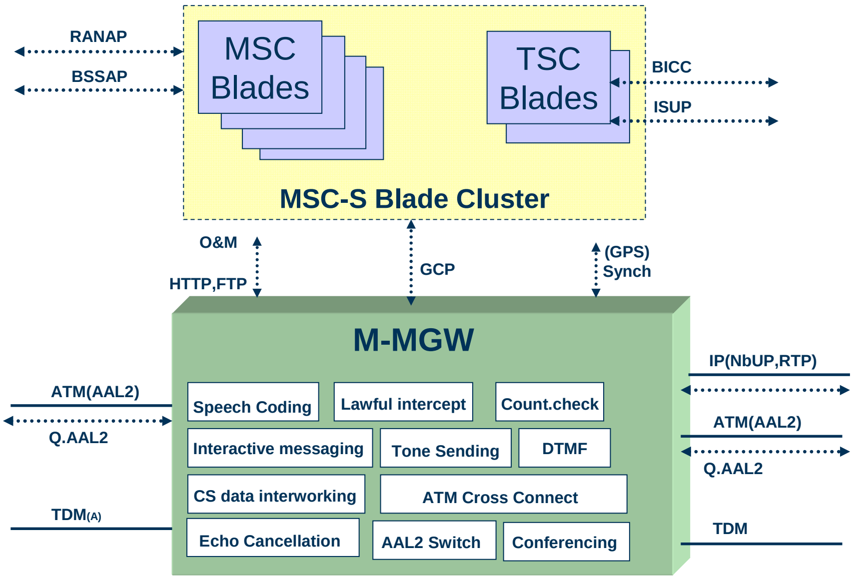


Figure 5-4: M-MGw System Structure

Signaling Gateway Application

The Signaling Gateway Application supports a number of functions related to SS7 signaling, such as Signaling Gateway, Signaling Transfer Point and SCCP Relay Point. The Signaling Gateway (SGW) function relays SS7 messages between TDM/ATM-based SS7 signaling networks and IP-based SS7 networks. Message routing between SS7 signaling data links of the same or different types is carried out by the Signaling Transfer Point (STP) function. The routing of messages in the Signaling Transfer Point is performed on MTP layer 3 level and is based on Destination Point Code (DPC) and Network Indicator (NI).

The STP supports the routing, based on DPC and NI, of signaling messages between:

- ATM and ATM links
- TDM and TDM links
- TDM and ATM links (MTP3 and MTP3b inter-working)
- IP and ATM links (M3UA and MTP3b inter-working)
- IP and TDM links (M3UA and MTP3 inter-working)

The STP requires that at least one signaling point code in the SS7 network is allocated to the node. Multiple point codes and network indicators are also supported, e.g. in network scenarios where the Signaling Transfer Point needs to be part of several SS7 networks.

The Signaling Gateway Application also supports SCCP relay as an optional feature. SCCP relay makes it possible to route SS7 messages within the same or different signaling networks based on Global Titles.

HARDWARE STRUCTURE

The M-MGW is based on the Ericsson Connectivity Packet Platform (CPP). The transmission support can easily be upgraded to match the applicable regional standard variant either by a SW upgrade or by adding or changing transmission boards. The robust, distributed multi-processor real-time telecom control system is built on the OSE Delta operating system.

The TDM/ATM/IP transport system of CPP includes a switch and a number of line interfaces. The internal switch has a duplicated switch core and a switch port on each board. The line interface boards provide the physical connection to TDM, ATM and IP bearers. The switch is controlled by the application Software via an API in the control system, or via standard signaling on the line interfaces. Extensive ATM functionality (ATM Cross-Connect, AAL2 for signaling and multiplexing, TDM Circuit Emulation and Inverse Multiplexing for ATM), as well as IP host functionality, is built into the platform.

The M-MGW is built in Generic Equipment Module (GEM) cabinets using CPP hardware arranged in a number of subracks mounted inside the cabinet. Each M-MGW subrack is configured with a number of plug-in-units such as Switch Core Boards (SCB), General Purpose Boards (GPB), Media Stream Boards (MSB) and Exchange Terminal (ET) boards of various kinds, all attached to a common backplane. This hardware structure provides a highly fault-tolerant node, which is easy to expand.

GMP V3 has 7 Basic Configurations:

- BC 3001, BC3002, BC3003, BC3004, BC3024, BC3051, BC3052.

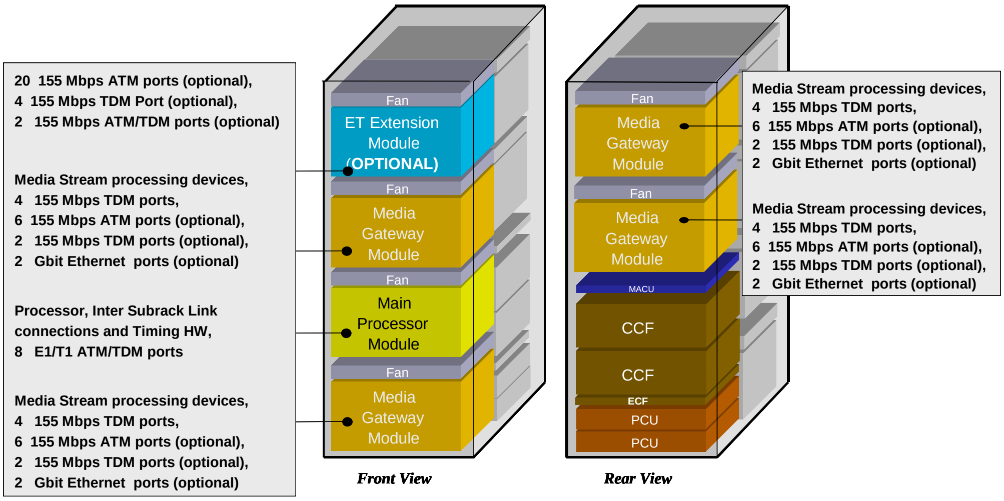


Figure 5-5: GMP V3.0 Configuration 3024

TRAFFIC HANDLING

Depending on network topology and the situation the M-MGW is handling, the node can assume different roles in the Mobile Core Network. It is not necessary to have several physical M-MGW nodes to take care of these different situations; one node can have a number of roles in the network.

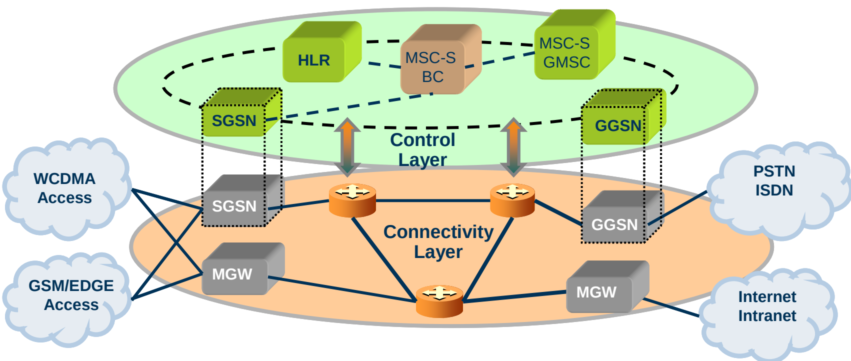


Figure 5-6: MGw in Traffic Handling

M-MGW as a Media Gateway

The M-MGW contains a full set of speech and data resources for performing modifications and additions to the Connectivity Layer. It also contains transport resources for performing protocol and Connectivity Layer conversions between different transport technologies (ATM, IP and TDM). These qualities of the M-MGW pertain to the entity known as Media Gateway in standardization, and MSC Servers on the Control Layer utilize the H.248-based GCP to control the actions performed on the Connectivity Layer by M-MGW acting as Media Gateway.

Example 1: When handling calls entering from the WCDMA network on the left and going to the ISDN/PSTN network on the left, MGW1 in acts as a Media Gateway, changing the bearer from ATM to TDM and speech coding from Adaptive Multi Rate (AMR) to Pulse Code Modulation (PCM).

Example 2: Traffic from ISDN/PSTN on the left enters the IP Core Network via MGW1. If the subscriber being called is within the WCDMA Radio Access Network on the right, traffic must be forwarded through the Core Network on top of IP bearer (Nb) to MGW2. In this example both MGW1 and MGw2 act as Media Gateways. MGW1 performs Connectivity Layer actions such as echo canceling and speech coding to AMR, and alters the bearer from TDM to IP. MGW2 changes the bearer from IP to ATM. The MSC server node controls allocation of these tasks between MGW1 and MGW2 with the help of Out-of-Band Transcoder Control (OoBTC) signaling.

Example 3: In case the operator has chosen to utilize Transcoder Free Operation (TrFO) in the Core Network, speech coding will only be carried out in the terminals of the subscriber in WCDMA Radio Access Network on the left and another subscriber in WCDMA Radio Access Network on the right when a connection is built between subscribers in question. Transmission of the payload in compressed format through the Core Network improves the speech quality and makes efficient use of backbone bandwidth possible. This kind of payload handling is possible on IP and ATM bearers; the only task for MGw1 and MGw2 is to do bearer conversion between WCDMA Radio Access Network and Core Network, where applicable.

M-MGW as an AAL2 Switch

For WCDMA access, the M-MGW can forward AMR-coded traffic right through the ATM Core Network over connections that are set up using Q.2630.2 (a.k.a. Q.AAL2) signaling. This helps the operators gain significant savings in network resource utilization, as the bandwidth required by AMR-coded speech is only a fraction of that of PCM-coded traffic.

Example 1: For calls entering from the WCDMA Radio Access Network on the left and going to the ISDN/PSTN network on the right, MGW1 acts as an AAL2 switch and sends the payload in the format used within the UTRAN (Iu) to the MGW2 on the other side of the Core Network. In this example, MGW2 acts as a Media Gateway. Please note that the Iu interface is terminated at MGw2, resulting in transcoder at the edge.

M-MGW as a Signaling Gateway

The M-MGW performs conversions between different signaling transport technologies and thereby contains the functionality of the logical node Signaling Gateway that appears next to MGw1 and MGw2. In addition to signaling bearer conversions, the Signaling Gateway also offers Signaling Transfer Point and SCCP Relay functionality.

Example: Control signaling for GSM traffic (BSSAP) is entering the Core Network from BSS on TDM bearer. M-MGW acting as a Signaling Gateway changes the bearer into IP (M3UA/SCTP/IP), and forwards the signaling traffic to the MSC Server.

M-MGW as an ATM Cross-Connect

The ATM Cross-Connect functionality in M-MGW can be useful for several purposes.

Example 1: There are needs for the WCDMA access nodes such as the RNC to exchange information with the server nodes on Control Layer of the Core Network. In cases like this, the MGw1 just forwards the ATM packets containing signaling information from WCDMA access to Control Layer and back.

Example 2: The data traffic from WCDMA access handled by the GPRS support nodes in the Core Network is forwarded through the MGW1 that acts as an ATM Cross-Connect.

The M-MGW can exist in operators' networks also without the functionality of logical nodes Media Gateway and Signaling Gateway. When used in this manner, the M-MGW acts as a pure ATM Cross-Connect/AAL2 switch for example in situations where the Mobile Softswitch Solution has not been introduced yet.

MEDIA STREAM HANDLING

The M-MGW contains a set of functions needed to support the circuit-switched speech services in WCDMA and GSM. With the help of these functions, the M-MGW can adapt the circuit-switched speech for transfer over different networks. Speech coding from PCM-coded voice to AMR-coded voice in WCDMA can be mentioned as an example.

The Media Stream Handling functionality is implemented in pooled devices that can be configured to support any of the individual functions listed below. With the help of this unique M-MGW quality, the operator can maximize the use of scarce network resources, such as echo cancellers.

A media stream device is a combination of software and hardware resources that performs Media Stream Handling. The software resources exist in the form of Media Stream Processing (MSP) software load modules. The hardware resources are in the form of a number of Digital Signal Processor (DSP) that exist on a MSB board.

Media Stream Handling

The fundamental Media Stream Handling functions are:

- Speech Coder including AMR2 and G.711. AMR2 is the default speech coding/decoding algorithm for WCDMA; G.711 is used on 2G/PSTN connections.

  The AMR2 speech coder operates in different modes, and selects the mode on the basis of quality measurements on both the uplink and downlink radio channel. During a call, the mode can change. The rate in the uplink channel can be different from that in the downlink channel. The selection of the encoder output rate, ´codec rate´, is a trade-off between speech quality and robustness. The speech coder complies with 3GPP 26.071

  Codec rates supported in AMR2: 12.2 kbit/s, 10.2 kbit/s, 7.95kbit/s, 7.40 kbit/s, 6.70 kbit/s, 5.90 kbit/s, 5.15 kbit/s, 4.75 kbit/s

- Extended Full Rate (EFR) is the speech coder for GSM. The Speech Coder handles the conversion between G.711-coded speech and EFR-coded speech.
- Echo Canceller attenuating the echo generated at the conversion between 4-wire and 2-wire transmission in the PSTN.
- Multi-Party Call functionality for bridging speech connections between several end-users involved in the same conversation.
- Tone Sender provides tones to be sent to end-users.
- DTMF Sender/Receiver sending DTMF tones to the far end of the connection as requested by a mobile terminal. DTMF tones are received in conjunction with e.g. the Interactive Messaging function.
- Interactive Messaging: informative messages on special conditions in the network or pertaining to the service in use are played to the end-users with the help of this function.
- The Code Answer and Tone Sender (CAT) function is used for maintenance purposes. It provides the capability to send tones from the Media Gateway in case of test calls. CAT also makes it possible to loop back the user plane of test calls to the originating side.
- Continuity Check (CC) is used to test the integrity of the speech path. In Common Channel Signaling systems, the speech channel and the signaling channel may take different paths in the network. Therefore, in order to verify that the operating conditions of the channel are acceptable, the CC function is used.

Voice Quality Enhancement

Two Voice Quality Enhancement functions are available in conjunction with active Echo Canceller.

Lawful Interception

Lawful Interception enables the monitoring of circuit-switched speech and data in the M-MGW. An MSC Server via the GCP controls the monitoring; M-MGW sends a copy of the speech and data to be monitored to the monitoring center over TDM or ATM connections.

Transmission at Nb interface

M-MGW supports transmission of compressed speech-coded (AMR and EFR-coded) speech over the ATM and IP bearers on the Nb interface. This function requires introduction of Out-of-Band Transcoder Control (OoBTC) for speech services in MSC Server. Bandwidth efficiency is achieved by transmitting the more less bandwidth demanding compressed speech on Nb interface instead of 64 kbps requiring PCM-coded speech. Compressed speech-coded speech over Nb interface makes it possible to achieve:

- Transcoder Free Operation (TrFO) for WCDMA mobile to mobile calls. TrFO improves speech quality and enables bandwidth efficient transport in core network. Improved speech quality is achieved by omitting the voice sample manipulation with transcoder. TrFO thus allows the transport of compressed information end-to-end for WCDMA mobile calls.

- Transcoder at the edge for WCDMA calls; The voice sample transcoding is performed at the M-MGw located at the interconnection point of the core network

- Voice compression for GSM speech traffic; The bandwidth efficiency can be achieved by transcoding the PCM-coded speech received to less bandwidth-consuming format over the core network.

TRANSCODER FREE OPERATION

Transcoder Free Operation is an outcome of 3GPP Out-of-Band Transcoder Control (OoBTC) procedures. The outcome of OoBTC procedures could be end-to-end transcoder free operation or transcoder at the network edge to PSTN or another PLMN.

TrFO is controlled by the MSC Server on the call control plane and must be supported by the Media Gateway (MGw) on the user plane. MSC-S BC performs the negotiation and selection of the codec used in the user plane in establishment of the speech calls, while the MGw handles the user plane protocols and provides a speech connection without transcoding, whenever possible.

TrFO (OoBTC) functionality applies in WCDMA with MSS for ATM or IP transport technologies.

This feature supports the basic codec negotiation principles used only during the call set-up phase.

This feature supports UMTS_AMR2 (Set7) and UMTS_AMR2 (Set1) modes in the Core Network. UMTS_AMR2 (Set7) is a single mode codec with 12.2 Kbps while UMTS_AMR2 (Set1) includes 12.2, 7.4, 5.9 and 4.75 Kbps modes.

This feature enables the MSC Server to use Bearer Independent Call Control (BICC) CS2 signaling procedures to control and establish:

- ‘Transcoder Free Operation’ for WCDMA to WCDMA calls - where the speech calls have no transcoders involved in the network. For mobile-to-mobile calls it means that speech encoding/decoding is only performed in the peer User Equipments (UE).
- ‘Transcoder at the edge’ - where transcoder free link carry speech compression up to the point where the speech is decoded to G.711 (PCM 64 Kbps) e.g. speech calls to or from an external network with TDM transport.

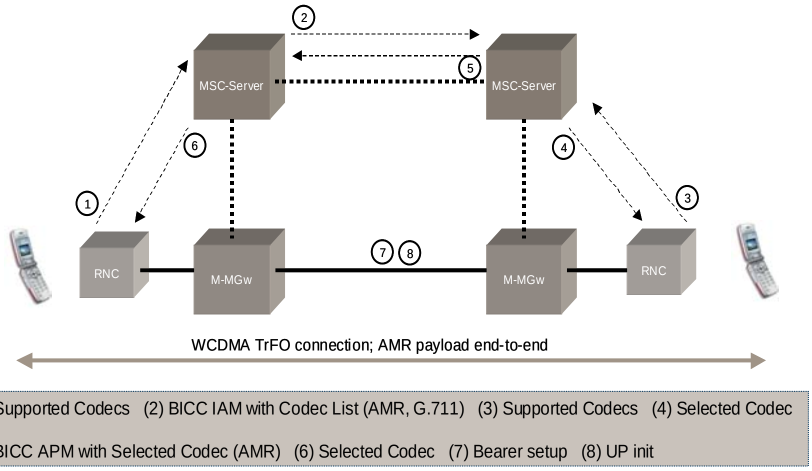


Figure 5-7: Transcoder Free Operation

TRANSCODER AT THE EDGE

- Transcoder at the edge: The transcoder is placed at the edge of the user plane where the voice is from AMR2 to G.711 (PCM 64 Kbps) e.g. speech calls to or from a Point of Interconnect (POI) with TDM transport. Requires OoBTC to be active in the MSC-S.

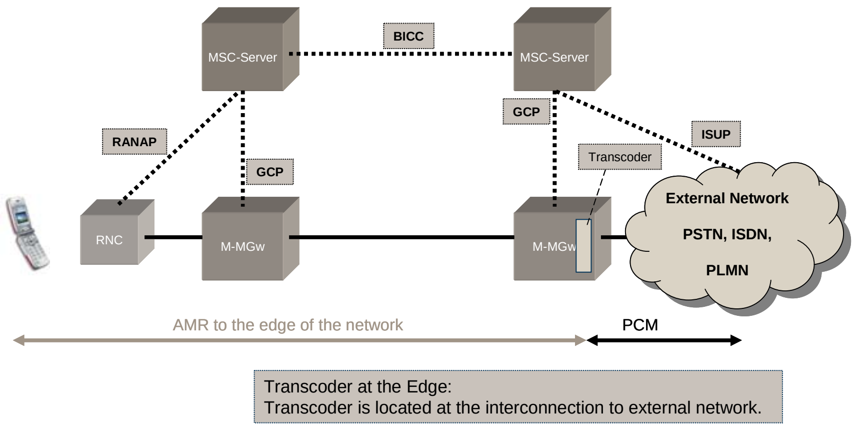


Figure 5-8: Transcoder at the Edge

Tandem Free Operation (TFO)

The TFO feature in M-MGW enables transfer of compressed speech over the 64 kbit/s PCM-coded interface towards 2G BSS, PSTN or other PLMN, and within the core network. Together with the feature Compressed Speech on Nb. TFO enables bandwidth efficient transport and improves speech quality for GSM connections, and in certain cases for WCDMA connections.

OoBTC has to be activated in MSC-S BC i.e. in the TSC Blades.

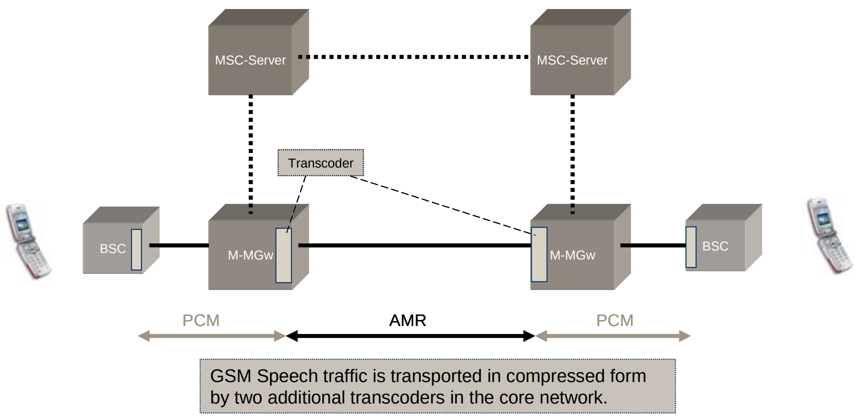


Figure 5-9: Tandem Free Operation - TFO

MSC SERVER DEFINITIONS FOR MSS

Regarding the new network architecture, there is the split of call control and bearer control, implying the split of the MSC/VLR logical node into two logical nodes: MSC Server/VLR and the Media Gateway (MGW).

With ATM/IP based core networks:

- GCP is used for controlling the CPP based Media Gateways.

- BICC is used for call control between the server nodes

When using a TDM core network, N-ISUP is used for call control between the server nodes. No GCP or CPP based Media Gateways are needed, but a CPP platform working only as a cross connect is needed between the core network and the RNCs.

GATEWAY CONTROL PROTOCOL

The Gateway Control Protocol (GCP) is used by the MSC Servers to control remote resources in the MGW, for a physically distributed network.

This includes controlling network access resources (i.e. GSM/WCDMA radio access network), creating connections between these network access resources in the transport network, and to insert devices (e.g. announcement machines) into the media stream.

Supported protocol stack:

- GCP/MTP3b/SSCF/SSCOP/AAL5/ATM
- GCP/M3UA/SCTP/IP
- GCP/SCTP/IP (MSS R5.0 and on)

The GCP feature is enhanced since MSS R5.0 to support the open standard H248.1 3GPP TS 29.232. This allows the MSC-S to control multi-vender M-MGW.

A new Ericsson Proprietary H.248 profile is introduced with support added for the new features in R13 (Mn interface, GCP over SCTP). The profile is referred to by the short name EP6. EP6 is based on OP2 and H.248.1 version 2 with parts still aligned with EP5

OP2 corresponds to 3GPP R6 release profile.

BICC (BEARER INDEPENDENT CALL CONTROL)

Bearer Independent Call Control (BICC) protocol provides the signaling functions required to support ATM & IP Core Networks. It supports the full set of narrow band ISDN services. Although BICC is designed to have a similar message structure and message name as ISUP, they are not peer to peer compatible. The specified BICC protocol is used between "Serving Nodes". On the Nc interface.

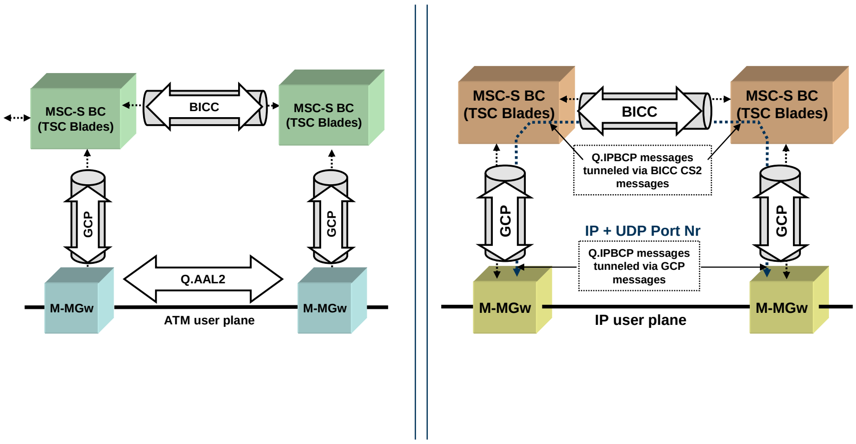


Figure 5-10: BICC in Different Networks

The Bearer Independent Call Control (BICC) feature provides a mechanism for transferring call control related data between MSC Servers. It is the defined, standardized call control protocol to be used in a layered architecture

BICC signaling protocol can be deployed over different signaling transport technologies. BICC uses a Generic Signaling Transport Converter, which makes BICC independent of the signaling transport used:

- BICC/MTP3b/SSCF/SSCOP/AAL5/ATM
- BICC/M3UA/SCTP/IP

BICC CS2 (capability set) is required to implement the Layered Architecture which separates the call control function from the bearer control function. BICC CS2 supports OoBTC (codec negotiation) between MSC-Servers which is required for TrFO, TFO and compressed speech in the core network.

BICC CALL SETUP CONCEPTS

The network architecture assumed by BICC requires new terminology and procedures to be defined. Some of the more important terms to know are:

- Call Instance Code (CIC)
- Bearer setup direction
- Codec negotiation
- Notification
- BICC tunneling

Call Instance Code

In an N-ISUP network, each PCM bearer channel is allocated a Circuit Identification Code (CIC). At call set-up, an incoming and outgoing circuit is seized and the respective CIC values are associated with a call instance within each node.

Since the bearer resource (and hence the CIC value) is the same at each end of the transmission link, the CIC can be said to uniquely associate the call instances in both nodes. That is, when sending SS7 messages, a CIC value is sufficient information to identify the call instance to which the message belongs and also the physical bearer that will be carrying speech traffic into and/or out of the switch.

The Mobile Softswitch Solution does not allow the notion of a physical circuit in the same way as N-ISUP, yet the call instances in each node must still be associated with each other in order to relate signaling messages to specific calls.

For this reason, the Call Instance Code is defined.

The Call Instance Code can be thought of as a “virtual” SS7 CIC – it does not correspond directly to a physical circuit, yet it ties together the call instances in each node. Unlike the N-ISUP CIC, the BICC CIC is four full octets in length. The total number of provisioned CIC values for any particular signaling association indicates the maximum number of signaling relations between the BICC peer entities; that is, the maximum number of BICC calls that can be simultaneously handled between two adjacent control servers.

It should be noted that where M-MGws peer with TDM / ISUP based vertically integrated network, Circuit Identification Codes and physical circuits are still used on the access side. This is the case of the TSC server having to map BICC call set-ups to Narrowband ISUP call set-ups. The physical circuit must still be indicated for calls to/from existing legacy ISUP networks.

Bearer Setup Direction

BICC call setup procedures may be classified according to the direction of the bearer set-up relative to the direction of call set-up. If the bearer is established in the same direction as the call set-up (that is, from the Initial address message (IAM) sender to the IAM receiver) as shown in figure below, the bearer setup is said to be in forward direction.

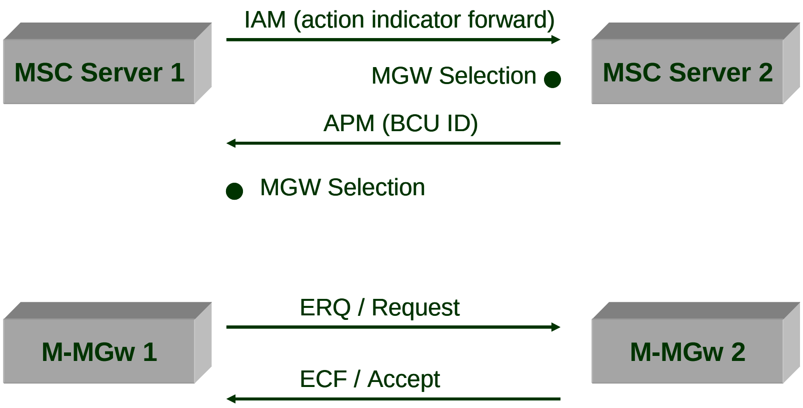


Figure 5-11. Forward Bearer Setup

If the bearer is set up in the opposite direction to the call set-up as shown in then the bearer set-up is said to be in the backward direction.

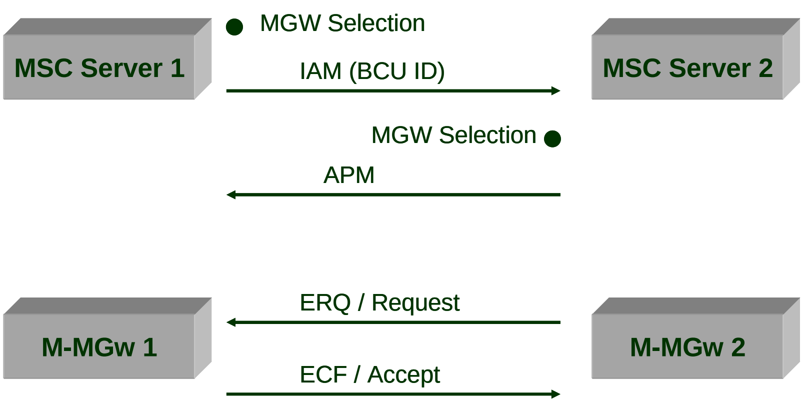


Figure 5-12. Backward Bearer Setup

Since MSS R5.0 release enhancements have been made to the MGW selection for Forward Bearer Setup, the selected MGW information can now be sent to the succeeding MSC-S (BCU-ID). This means:

- Forward bearer set up can be used for all cases; there is no need to use Backward Bearer Set up for PSTN to WCDMA Access.
- OoBTC can be used together with optimized MGW Selection.

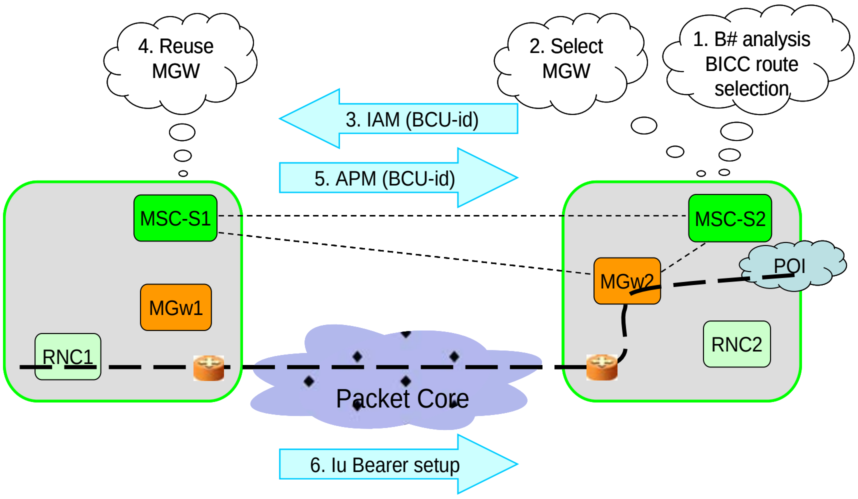


Figure 5-13: Backward Bearer Setup with BCUID Included in IAM

Benefits

The operator can use Forward Bearer Set up and still achieve a common MGW at the network edge for all call cases.

- Optimal MGW selection for all call cases: Reduced number of MGW nodes involved in a call which reduces CAPEX
- The ability to use the same bearer set up method (forward) for all call cases simplifies network configuration which reduces OPEX
- Allows using optimized MGW selection together with OoBTC procedures; compressed speech in the Core Network and Codec on the Edge is achievable for any call (Codec negotiation requires Forward Bearer Set up).

MEDIA GATEWAY SELECTION

Media Gateway selection enables a Server node to select a Media Gateway which is most suitable for a given traffic case. This is needed to perform flexible routing of the payload within the core network and to optimize the transmission bandwidth.

The media gateway selection can depend on different conditions:

- Type of access.
  TDM accesses like GSM subscribers and ISUP or Chinese TUP trunks are connected to specific MGWs, which restricts the MGW selection.

- Node configuration.
  MGWs can be grouped into Media Gateway Groups (MGGs). MGWs within a MGG can have priority over other MGWs in the same MGG. The MGG can be connected to a route. If a MGG is defined on a route then a MGW from this MGG must be selected. MGWs belonging to the same group must be able to serve calls towards a certain destination. No checks are performed in the server when the MGG is configured.

- Information in the bearer independent call control signaling (for those cases where a preceding or succeeding network entity has already selected a media gateway).
  MGWs already selected by a preceding or a succeeding server are taken into account, if the information is available at the time of selection.

- Availability of the media gateways.

- BICC route configuration (bearer set-up direction).

- The MGW selection result will be influenced by pre-requisite from other features (i.e. codec negotiation, which is used for the OoBTC feature, requires that the bearer set-up direction is “Forward Bearer Setup”.

The most important general rules followed by the MGW selection are:

1. The MGW selection is **destination dependent**.

2. The Server will based on the configuration try to select a **common MGW** for the incoming and for the outgoing access of the call. If this is not possible, the Server will use different MGWs for incoming and outgoing access.

3. If the incoming access is a BICC trunk access the BCU-ID received from the **preceding** node in case of backward bearer set up will be taken into consideration during MGW selection.
If the outgoing access is a BICC trunk access the BCU-ID ID received from the **succeeding** node in case of deferred MGW selection (forward bearer set up) will be taken into consideration during MGW selection.

The Media Gateways are grouped in *Media Gateway Groups* (MGG).

Media Gateways belonging to the same group can serve a call towards a certain destination. The MSC server can access the resources provided by the Media Gateway in that group by means of GCP signaling. The Media Gateways in a group have the same capabilities and should serve a common destination.

A Media Gateway can belong to various Media Gateway Groups. After the Media Gateway Group for a certain call has been selected, the MSC Server can choose a dedicated Media Gateway from that group.

This feature also enables external networks to be accessed directly via a remote Media Getaway.

The existing command, EXRBC and the related parameter RGSPAR, used for definition of route data, will also be used to attach a Media Gateway Group to a route.

New commands are introduced for:

Media Gateway definition handling (NRGWI, NRGWE, NRGWP)
Media Gateway manual blocking handling (NRGBI, NRGBE)
Media Gateway Group definition handling (NRGGI, NRGGE, NRGGP)

Data Transcript Example

In the following data transcript examples you can check the BICC, ISUP routes definition and also the MGW node inside MSC-S Blade Cluster.

Notice that the data transcript now needs to be specific for each part of MSC-S BC, that is one file for each MSC, TSC blades and SPX nodes.

During the next text and figures they are representing just one MSC, TSC or SPX nodes.

Connection to another MSC-Server

The MSC-S Blade Cluster can be connected with a Classical MSC-S or another MSC-S BC. Both cases BICC protocol is used. BICC protocol is handled by TSC Blades only. Analyze the figure below:

- **Other MSC-S BC (TSC Blades):**

```
C7SPI:SP=2-2302;
C7SPC:SP=2-2302,NET=IP;          !TSC Blade 1!
C7PNC:SP=2-2302, SPID=TSC2302;
C7MLC:SP=2-2302, ML=LONG;

C7SPI:SP=2-2602;
C7SPC:SP=2-2602,NET=IP;          !TSC Blade 2!
C7PNC:SP=2-2602, SPID=TSC2602;
C7MLC:SP=2-2602, ML=LONG;
```

Figure 5-14: Definition to another MSC-S TSC Blades

The external node (another MSC-S BC in this example) sees the MSC-S BC as an exchange with two different signaling point now. Two TSCs are used for load sharing and redundancy purposes.

- **Route Definition:**

```
EXROI:R=BIA302O&BIA302I,DETY=BID,FNC=3,SP=2-2302;
EXRBC:R=BIA302O&BIA302I,RGPAR=OoBTC-2;
EXROI:R=BIA602O&BIA602I,DETY=BID,FNC=3,SP=2-2602;
EXRBC:R=BIA302O&BIA302I,RGPAR=OoBTC-2;
```

- **Device allocation:**

```
EXDRI:R=BIA302O&BIA302I,DEV=BID-0&&-31,BCIC=0;
EXDRI:R=BIA602O&BIA602I,DEV=BID-32&&-63,BCIC=32;
```

- **Deblock devices:**

```
BLODE:DEV=BID-0&&-31;
BLODE:DEV=BID-32&&-63;
```

Figure 5-15: BICC Routes TSC Blades

BICC continues using the device concept in AXE. *The BICC devices are software devices*. Therefore commands that define routes and connect devices on the routes are also used for BICC (EXROI/E/P, EXRBC, EXDRI/E/P, EXDEP, STDEP, BLODI/E). Note that BICC devices have no corresponding hardware connection. Thus device connection to SNT (EXDUI) is not required .

The parameter, BCIC, related to BICC is added to the command EXDRI.

The EXRBC command changes the default values or adds new parameters to the given route. OoBTC-2 is used for outgoing routes only.

OOBTC allowed on this route if TMR or USI is "speech" or "3.1kHz Audio".

Please check the Application Information BID for more details.

Signaling Transport Definition to another MSC-S

The MSC-S BC uses VLANs internally to communicate to each part of its components i.e. MSC, TSC, SPX and so on. Also to separate the different traffic inside such as SS7 signaling, O&M traffic, Intro protocol, Cluster Handler and others.

For SS7 Signaling between blades it is necessary to define the VLAN 1001, which is used for internal signaling between blades and SPXs.

All the VLANS should be also defined in the IS nodes previously. The VLAN 1001 is also know as INT-SIG which is the parameter used in the blades.

- **IP Connection in the TSC Blades (Internal VLAN):**
  IHIFI:NVIF=INT-SIG;
  IHIFC:NVIF=INT-SIG, ADD, IP=192.168.1.x, NETMASK=255.255.255.0, ARP=YES;

- **SCTP End Point Initialization:**
  IHBII:LIP="192.168.1.x",EPID=BL2SPX,USER=M3UA, SCTPCP, MODE=CLIENT, LPN=2905;

- **SCTP Association Initialization:**
  IHADI:SAID=BICC2SPX1,EPID=BL2SPX, RIP="SPX1 IP1"&"SPX1 IP2", SCTPCP, RPN=2905;
  IHADI:SAID=BICC2SPX2,EPID=BL2SPX, RIP="SPX2 IP1"&"SPX2 IP2", SCTPCP, RPN=2905;

Figure 5-16: Signaling transport TSC Blades – Internal Communication between Blades/SPX

The SCTPCP parameter indicates that the SIGTRAN here is defined for IP on CP and not for GARP (IP on RP).

Below is showing the associations activation to/from SPX nodes.

- **SCTP Association Activation:**
  IHASC:SAID=BICC2SPX1, PROC=ESTB, USER=M3UA, SCTPCP;
  IHASC:SAID=BICC2SPX2, PROC=ESTB, USER=M3UA, SCTPCP;

  M3ASC:SAID=BICC2SPX1, PROC=ACT;
  M3ASC:SAID=BICC2SPX2, PROC=ACT;

- **M3UA Routing Definition and Activation:**
  M3RSI:DEST=2-2302,SAID=BICC2SPX1,PRIO=1, BMODE=PEER;
  M3RSI:DEST=2-2602,SAID=BICC2SPX2,PRIO=1, BMODE=PEER;

  M3RAI:DEST=2-2302;
  M3RAI:DEST=2-2602;

Figure 5-17: Signaling transport TSC Blades

The signaling pass through SPX nodes before reach the final destination that is the other MSC-S BC.

Media Gateway Definition

The M-MGWs are defined in all MSC and TSC Blades. Follow:

- **MGWs signaling points:**
  C7SPI:SP=2-201;
  C7SPC:SP=2-201,NET=IP; !MGW1"
  C7PNC:SP=2-201, SPID=MGW1;
  C7MLC:SP=2-201, ML=LONG;

  C7SPI:SP=2-202;
  C7SPC:SP=2-202,NET=BOTH; !MGW2!
  C7PNC:SP=2-202, SPID=MGW2;
  C7MLC:SP=2-202, ML=LONG;

Figure 5-18: Definition of MGWs Common for MSC and TSC Blades

The GCP signaling transport to the MGW is defined passing through SPX nodes that means that the GCP is using M3UA/SCTP/IP otherwise it could pass directly to the ISER node.

- **IP Connection in the Blades (Internal VLAN):**
  IHIFI:NVIF=INT-SIG;
  IHIFC:NVIF=INT-SIG, ADD, IP=192.168.1.x, NETMASK=255.255.255.0, ARP=YES;

- **SCTP End Point Initialization:**
  IHBII:LIP="192.168.1.x",EPID=BL2SPX,USER=M3UA, SCTPCP, MODE=CLIENT, LPN=2905;

- **SCTP Association Initialization:**
  IHADI:SAID=M3SPX1,EPID=BL2SPX, RIP="SPX1 IP1"&"SPX1 IP2", SCTPCP, RPN=2905;
  IHADI:SAID=M3SPX2,EPID=BL2SPX, RIP="SPX2 IP1"&"SPX2 IP2", SCTPCP, RPN=2905;

Figure 5-19: Signaling transport MSC and TSC Blades (1/2)

- **SCTP Association Activation:**
  IHASC:SAID=M3SPX1, PROC=ESTB, USER=M3UA, SCTPCP;
  IHASC:SAID=M3SPX2, PROC=ESTB, USER=M3UA, SCTPCP;

  M3ASC:SAID=M3SPX1, PROC=ACT;
  M3ASC:SAID=M3SPX2, PROC=ACT;

- **M3UA Routing Definition and Activation:**
  M3RSI:DEST=2-201,SAID=M3SPX1,PRIO=1, BMODE=PEER;
  M3RSI:DEST=2-202,SAID=M3SPX2,PRIO=1, BMODE=PEER;

  M3RAI:DEST=2-201;
  M3RAI:DEST=2-202;

Figure 5-20: Signaling transport MSC and TSC Blades (2/2)

As recommend in the Signaling User Guide for MSC-S BC, all M3UA traffic pass to SPX and then to the final destination. Note that the IP connection is slightly different as SPX nodes are Dual Side CPs type.

- **IP Connection used from SPX to/from Blades (Internal VLAN):**
  IHIFI:VIF=ETHA-1001;
  IHIFI:VIF=ETHB-1001;
  IHIFC:VIF=ETHA-1001, ADD, IP=192.168.1.y, NETMASK=255.255.255.0, ARP=YES;
  IHIFC:VIF=ETHA-1001, ADD, IP=192.168.1.z, NETMASK=255.255.255.0, ARP=YES;

- **SCTP End Point Initialization:**
  IHBII:LIP="192.168.1.y"&"192.168.1.z", EPID=IM3S390, USER=M3UA, SCTPCP, MODE=SERVER, LPN=2905;

- **SCTP Association Initialization:**
  IHADI:SAID=IM3BLD303,EPID=IM3S390,RIP="192.168.1.x",SCTPCP;
  IHADI:SAID=IM3BLD304,EPID=IM3S390,RIP="192.168.1.x",SCTPCP;
  …

Figure 5-21: Signaling transport SPX Nodes – Internal Communication between SPX/Blades

The RIP (Remote IP Address) is the MSC and TSC Blades addresses.

- **IP Connection used from SPX to/from Blades (Internal VLAN):**
  IHIFI:VIF=ETHA-2001;
  IHIFI:VIF=ETHB-2002;
  IHIFC:VIF=ETHA-2001, ADD, IP=10.2.111.58, NETMASK=255.255.255.0, ARP=YES;
  IHIFC:VIF=ETHA-2002, ADD, IP=10.2.111.122, NETMASK=255.255.255.0, ARP=YES;
  IHRHC:VIF=ETHA-2001,DEFGW=10.2.111.61,ADD,PREF=1;
  IHRHC:VIF=ETHA-2001,DEFGW=10.2.111.62,ADD,PREF=0;
  IHRHC:VIF=ETHB-2002,DEFGW=10.2.111.125,ADD,PREF=0;
  IHRHC:VIF=ETHB-2002,DEFGW=10.2.111.126,ADD,PREF=1;

- **SCTP End Point Initialization:**
  IHBII:LIP="10.2.111.58"&"10.2.111.122", EPID=EPEXT, USER=M3UA, SCTPCP, MODE=SERVER, LPN=5000;

- **SCTP Association Initialization:**
  IHADI:SAID=EMSC2302,EPID=EPEXT,RIP="10.8.1.30",SCTPCP; !Another MSC-S BC!
  IHADI:SAID=EMSC2602,EPID=EPEXT,RIP="10.8.1.121",SCTPCP;
  IHADI:SAID=EMGW201,EPID=EPEXT,RIP="10.10.1.9",SCTPCP; !MGW!

Figure 5-22: Signaling transport SPX Nodes – External Communication to others MSC-S, MGWs

Now, the RIP here belongs to the IP Address of each external Nodes such as MSC-S, MGW1…

- **SCTP Association Activation:**
  IHASC:SAID=EMSC2302, PROC=ESTB, USER=M3UA, SCTPCP;
  IHASC:SAID=EMSC2602, PROC=ESTB, USER=M3UA, SCTPCP;
  IHASC:SAID=EMGW201, PROC=ESTB, USER=M3UA, SCTPCP;

  M3ASC:SAID=EMSC2302, PROC=ACT;
  M3ASC:SAID=EMSC2602, PROC=ACT
  M3ASC:SAID=EMGW201, PROC=ACT;

- **M3UA Routing Definition and Activation:**
  M3RSI:DEST=2-2302, SAID=EMSC2302, PRIO=1, BMODE=PEER;
  M3RSI:DEST=2-2602, SAID=EMSC2602, PRIO=1, BMODE=PEER;
  M3RSI:DEST=2-201, SAID=EMGW201, PRIO=1, BMODE=PEER;

  M3RAI:DEST=2-2302;
  M3RAI:DEST=2-2602;
  M3RAI:DEST=2-201;
  …

Figure 5-23: Signaling transport SPX Nodes – M3UA Routing

Define Media Gateway Group

- **MGW Definition in both MSC and TSC Blades:**
  NRGWI: MG=MGW1, BCUID=201, SIGTR=ITUMTP, SIGADDR=2-201;
  NRGWI: MG=MGW2, BCUID=202, SIGTR=ITUMTP, SIGADDR=2-202;

- **MGW Group for ISUP route:**
  NRGGI:MGG=ISUP, MG=MGW1, RESTRICTED;

- **Define a MGG with for RNC with Priority:**
  NRGGI:MGG=RNC, MGP=MGW1, MG=MGW2, ANYMG;
  EXRBC: R=RNC1O, RGSPAR=MGG-RNC; !Only for MSC Blades!

- **MGG for BICC Routes (TSC Blades):**
  NRGGI:MGG="BICC";
  EXRBC:R=BIA302O, RGSPAR=MGG-BICC;

Figure 5-24: MGW & MGG Definition MSC and TSC Blades

MGG Types:

One MGW only in a RESTICTED MGG (TDM Access).

One DEFAULT MGG per Node.

The MG "MGW1" is marked as prioritized and is assigned to the already defined MGG "MGG3".

The ANYMG specifies that any MGW defined in the Node can used if available, priority is given to MGW1 and MGW2.

ANYMG is used with an ATM Backbone.

Assign MGG to a Route

EXRBC:R=ROUTE,RGSPAR=MGG-BICC;

Assign Bearer Setup Direction to a Route

EXRBC is used to modify the default setting for the bearer setup direction. The parameter **FBBS** (Forward Backward Bearer Setup) is used on outgoing BID routes.

PBSD (Preferred Bearer Setup Direction) is applicable for incoming MUIUCM routes. The different values are explained in

EXRBC:R=route,RGPAR=FBBS- ;

For BICC I/O Routes & TDM Routes FBBS is used.

- 0- Default Value
- 1= Bearer Establishment in Forward Direction.
- 2= Bearer Establishment in Backward Direction.

For Incoming RNC routes PBSD is used.

- BACKD (backward bearer setup)
- FORWD (forward bearer setup)

Remote ISUP devices and Route

Here is showing the definition of ISUP route using the remote devices UPDR which are physically allocated in the M-MGW node.

- **Definition of PSTN SP:**
  C7SPI:SP=2-303,OWNSP=2-310;
  C7PNC:SP=2-310,SPID=PSTN1;

- **Route definition:**
  EXROI:R=UPDR3O&UPDR3I, DETY=UPDR, FNC=3, SI=ISUP4, SP=2-310;
  EXRBC:R=UPDR3O,RGSPAR=MGG-ISUP;

- **Remote device allocation:**
  NTCOI:SNT=RTDMA-0,EXTP=2-2-0,MG=MGW1,SNTV=0
  NTCOI:SNT=RTDMA-1,EXTP=2-2-1,MG=MGW1,SNTV=0

  EXDUI:SNT=RTDMA-0,DEV=UPDR-0&&-31;
  EXDUI:SNT=RTDMA-1,DEV=UPDR-32&&-63;

Figure 5-25: ISUP Route TSC Blades only

- **Device connections:**
  EXDRI:R=UPDR3O&UPDR3I,DEV=UPDR-2&&-31,MISC1=2;
  EXDRI:R=UPDR3O&UPDR3I,DEV=UPDR-34&&-63,MISC1=34;

  EXDAI:DEV=UPDR-2&&-31;
  EXDAI:DEV=UPDR-34&&-64;

  NTBLE:SNT=RTDMA-0;
  NTBLE:SNT=RTDMA-1;

  BLODE:DEV=UPDR-2&&-31;
  BLODE:DEV=UPDR-34&&-63;

Figure 5-26: Remote ISUP Devices Connection TSC Blades only

The number of E1s between MGW1 and PSTN should be divided evenly by the two TSC Blades in order to have load sharing properly as TDM devices for MSC-S BC is manually distributed.

In this example, there just 2 E1s between MGW1 and PSTN.

A TDM device is a software representation in the MSC or TSC Blade. In case of UPDR is controlled by TSC and MRALT, by MSC Blades . It corresponds to a 64 kbit/s digital channel in MGW. The TDM device is usually connected to a route and a CIC (TUP and ISUP signaling). The TDM device keeps track of, for instance, the state of the channel (idle/busy) and blockings (remote and local hardware/maintenance blockings).

A local control TDM device is used when a TDM device is related to a media gateway that is combined with the MSC Server.

A remote control TDM device is used when a TDM device is related to a media gateway that is not combined with the MSC Server.

A Remote control TDM device is also connected to a TDM Termination ID (in addition to CIC) according to H.248.

From an operator point of view, a remote TDM access will be very similar to the local TDM access, but the hardware, with which it is associated, is external to the node.

From an operational point of view, the remote TDM handling will make use of the existing route, device, CIC and SNT concepts (and consequently of the related commands e.g. NTCOI, EXDUI).

The association of a remote TDM access in a MGW with its logical representation in the MSC will be created by means of the external SNT (E-SNT). The E-SNT will be used to support the remote TDM access grouping.

MSC IN POOL

INTRODUCTION

The MSC Pool feature was introduced for GSM/WCDMA in the R11/R4 release. GSM R13 / WCDMA R7 supports MSC/MSC-S in the pool for GSM and WCDMA with the caveat of needing separate pools for each Radio Access type. The feature provides a more robust core network by eliminating the single point of failure i.e. one BSC/RNC connected to one MSC/MSC-S. MSC pool can be implemented for both the layered and Classical network designs. The layered architecture is best suited to MSC Pool implementation with Sigtran being the preferred signaling transport system.

A **MSC Pool** is defined as a pool of MSC nodes linked to a number of BSC and/or RNC nodes. Each BSC/RNC is connected to each MSC node of the pool.

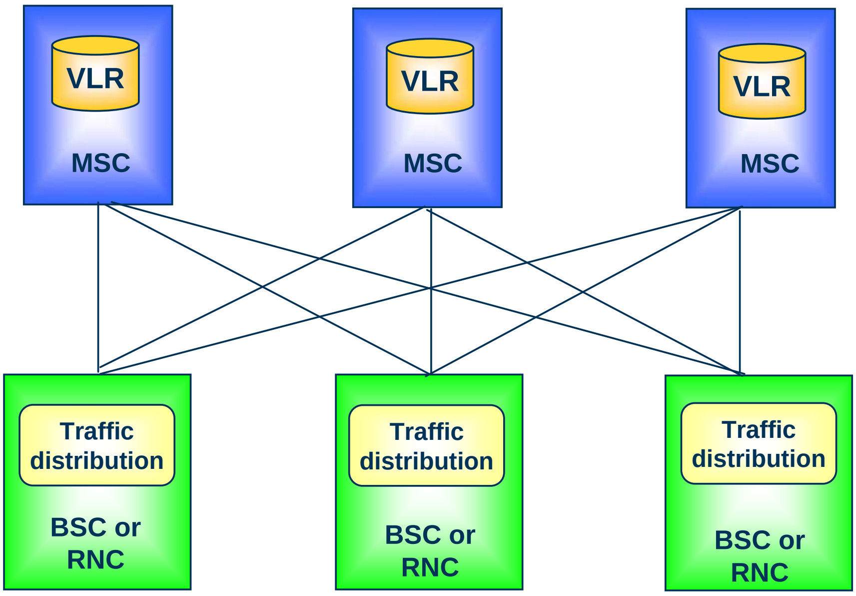


Figure 5-27: MSC in POOL

All MSCs within a pool need to be connected to all BSCs/RNCs, so links need to be set up between the nodes.

All MSCs within a pool need to have the same BSC/cell – RNC/SAI related settings.

An MSC of the pool has no knowledge about the behavior of the surrounding MSC nodes, whether they belong to the same MSC pool or not. The MSC pool concept is mainly applicable for the BSC/RNC, as the BSC/RNC can see a pool of MSC nodes.

Each MSC node in a pool shares the same service area with all other MSCs in the pool. If an MSC is removed from the pool the subscribers of the removed MSC will be distributed to the other MSCs of the pool. This feature provides MSC redundancy and improved network service availability.

Each BSC / RNC in the pool is connected via the A interface / Iu CS interface to each MSC/VLR's of the pool. This is referred to as the A flex and Iu flex in the telecommunication community.

When a subscriber roams into a MSC Pool Service Area, the involved BSC/RNC selects one of the MSC's in the pool according to pre-defined traffic distribution algorithm based on the capacity figures of the MSC’s in the Pool. The subscriber registers in the selected MSC and remains registered in the same MSC until he moves out of the MSC Pool Service Area.

When the subscriber moves from one location area to another within the MSC Pool Service Area, the new BSC/RNC will be informed by the MS about the identity of the MSC where it is registered. In order to implement this functionality without impacts on the Mobile Stations, the TMSI is modified to carry the NRI.

In case MS has roamed outside the MSC Pool Area there may be a need to fetch the IMSI and the security related data from the previous MSC. In order to find out the correct co-operating MSC within the pool, the old TMSI (NRI) is analyzed in the new MSC. In case the previous MSC is part of a MSC pool, then TMSI points out to so called proxy MSC of that MSC pool, which has knowledge of all MSC’s in this MSC pool. This proxy MSC relays the signaling between new MSC and the correct previous MSC.

Note: BSC/RNC configurations have to be adapted to the MSC-Pool concepts.

SOME NEW CONCEPTS

Neighboring MSC Group

The MSCs in the neighboring MSC group are grouped together (max.16) for administration purposes to distribute the inter-MSC handover/SRNS relocation (from outside the pool) in order to achieve a better load distribution. With the neighboring MSC group, it is allowed to distribute the inter-MSC handovers/SRNS relocations between the group members.

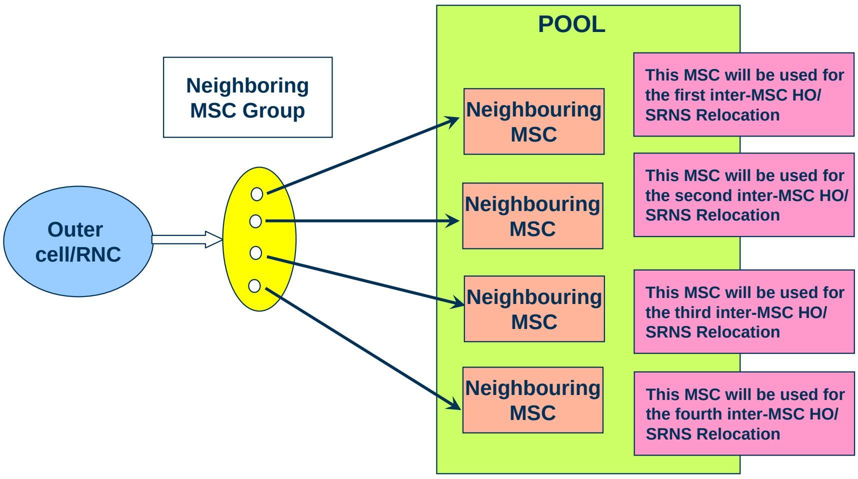


Figure 5-28: Neighbouring MSC Group

Network Resource Indicator (NRI)

The NRI has been introduced to perform the MSC routing discrimination on BSC/RNC. The routing will be performed based on the NRI.

The NRI is coded inside the TMSI. It has a configurable length between 0 to 10 bits, located within bits 14 to 23. The most significant bit (MSB) is bit 23. If the full 10 bits are not used as NRI values, then these bits are used for TMSI ‘sThe NRI length is configured by the operator and indicates the number of bits that shall be used for the NRI field. NRI univocally identifies a MSC within a Pool. The NRI value is inserted into the TMSI, so that it shall be possible to store it into the SIM card. The length 0 bits means that NRI is not in use and therefore MSC in Pool function is not in use.

The NRI is given by MML command when taking a new MSC into the Pool. At least one NRI value has to be assigned to an MSC serving in an MSC pool.

There will be major disturbances in the pool traffic when changing the NRI length. Therefore, the planning of the NRI length must be done very carefully, taking into consideration the future expansion of the MSCs in order to avoid changes in the NRI length. The assumption is that the NRI length is stable and changes of NRI length are rare.

A deleted NRI in the MSC/VLR shall force a re-allocation of a new TMSI with a new NRI at the next mobile originating procedure (for example location update, CM service request).

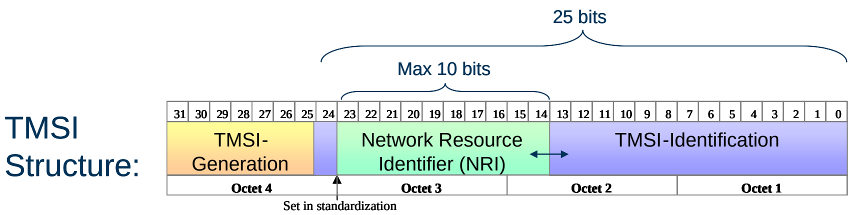


Figure 5-29: Network Resource Identity NRI

MSC Pool Area

The MSC pool area is a collection of BSC or RNC service areas or both that are served by one or more MSC nodes in parallel that share the traffic from the pool area. This area an MS can roam without a need to change the serving MSC node. A BSC/RNC service area must belong completely to the one or more MSC pool area(s).All the MSC nodes in such a pool area share the responsibility of handling all the MSs, in all the LAs of the pool area.

Once the MS has entered a new pool area, in normal operation the MS is served by the same MSC as long as the MS roams within the pool area

Proxy MSC

The cooperating VLR functionality is also impacted when a pool is built, as several MSC/VLRs serve the same location area. A mechanism is needed to ensure that the MAP messages requesting the subscriber data reach the right (previous) VLR. The proxy MSC/VLR function has been introduced to provide this mechanism. An MSC/VLR supporting the proxy functionality is named proxy MSC/VLR.

Old MSC/VLR nodes or MSC/VLR nodes that are not configured with any knowledge of NRI values are not aware of that multiple MSC/VLR nodes can serve the same LA (s). They can only derive one co-operating MSC/VLR address for each LA and can therefore only contact one cooperating MSC/VLR for each LA.

In networks that contains both: MSC in pool and old MSCs there is a need to introduce the ‘Proxy functionality’. This must be defined in at least one MSC/VLR node which has common LA in the pool.

The proxy MSC/VLR relays signaling between two different MSC/VLR nodes. The proxy MSC/VLR will have the knowledge of all MSC/VLR addresses serving the same LA and all NRI values assigned to these MSC/VLR nodes.

The proxy MSC has a table containing all NRIs used inside the pool with their associated MSC/VLRs so modifications in the NRI addressing space have to be done also in all the proxies of the pool in order to keep consistent data. When the proxy MSC receives a MAP message asking for the mobile station IMSI and authentication data, it will extract the NRI from the received TMSI and will redirect the message to the right VLR.

Any MSC belonging to the pool can act as a proxy, provided that it has knowledge of the complete set of NRI with its correspondent MSC used in the pool.

Co-operation VLR data handling

In case the MS has roamed out side the MSC Pool Area there may be a need to fetch the IMSI and the security related data from the previous MSC. In order to find out the correct co-operating MSC within the pool, the old TMSI is analyzed in the new MSC. In case the previous MSC is part of a MSC pool, then TMSI points out to so called proxy MSC of that MSC pool, which has knowledge of all MSCs in this MSC pool. This proxy MSC relays the signaling between new MSC and the correct previous MSC.

Load re-distribution

The load re-distribution functionality enables operator to empty an MSC within the pool from the traffic in order to perform maintenance activities like updates, upgrades and migration without any traffic disturbance. After the maintenance this MSC can be again filled-up with traffic. This activity can be initiated by commands in the MSC.

Note: It has to be noted that when MSC pool contains MSCs with different level of functionality, e.g. during a SW upgrade, the end-user will get different level of service depending on which MSC he is connected to.

Charging

Charging will be handled in the MSC in which the subscriber is registered independent of the current location of the subscriber.

DEFINITION IN MSC

The MSC in pool functionality will be activated when defining an NRI length greater than 0. Also, definition of the NRI length and own NRI values should be done on every MSC that will belong to the pool.

MGNDI:NRIL=6,NRIV=1&2&3;

The command sets the NRI length to 6 and defines the NRI values 1 and 2 and 3, up to 8 NRI's can be defined per MSC.

MGPTI:VLRADDR=4-35868765,NRIV=1;

The VLR address is given in international format.

The specified VLR address is added to the Proxy Table along with the given NRI value.

MGMGI:MSCG=MSCG, MSC=msc1inpool;

New MSCG is defined with MSC1inpool as the first MSC belonging to MSCG in the MSC Server/VLR.

MGMGI:MSCG=MSCG, MSC=msc2inpool;

MSC2inpool is added to the existing MSCG in the MSC Server/VLR. MSCG contains now two MSCs.

- **NRI Definition:**
  MGNDI:NRIL=6,NRIV=1&2&3;
- **Define Proxy table:**
  MGPTI:VLRADDR=4-35868765,NRIV=1;
- **Define neighboring MSC groups:**
  MGMGI:MSCG=MSCG, MSC=msc1inpool;
- **Add MSC to the existing MSCG:**
  MGMGI:MSCG=MSCG, MSC=msc2inpool;

Figure 5-30: Definition in MSC

New AXE parameters

TMSI use is mandatory:
TMSIPAR (parameter set: GSMMMSC)

Value	Effect	Note
0	TMSI not allocated	Default value
1	TMSI allocated only on encrypted connections	
2	TMSI allocated on all connections	

Figure 5-31: Pool Network: Parameters (1

TMSI use is mandatory:
TMSILAIMSC (parameter set: GSMMMSC)

Value	Effect	Note
0	TMSI allocated only once	Default value
1	TMSI allocated every time when mobile subscriber changes location area	

Figure 5-32: Pool Network: Parameters (2)

- **ADMHOMSCPOOL**
  Activation/Deactivation of the administration of the handover to MSC pool.

- **MSCREQNUM**
  Defines the maximum number of trials to select a target MSC from the neighboring MSC group.
- **OWNCNID**
  Defines the own core network ID (CN-ID) of an MSC/VLR.
- **TIMNRICHGM**
  Defines the time supervision value during the handling of the changes in the NRI list.

Modified AXE parameters:

- **OWNMCCM**
  Defines the own Mobile Country Code (MCC) of an MSC.
- **OWNMNCM**
  Defines the own Mobile Network Code (MNC) of an MSC.

New SAEs:

- **SAE 500, MCVLRD** (APT SAE)
  Stores data for the Proxy Table.
- **SAE 629, MCVLRD** (APT SAE)
  Stores store the cooperating VLRs belonging to the MSC Pool serving the location areas identified by their LAIs.
- **SAE 630, MCVLRD** (APT SAE)
  Stores the NRI values associated to each cooperating VLR, defined for a LAI, belonging to the MSC Pool serving the location areas identified by their LAI.
- **SAE 36, MTMSIAN** (APT SAE)
  Stores data for visiting mobile subscribers.
- **SAE 1141, MTRAN** (APT SAE)
  Stores data for neighbouring Mobile Services Switching Centre Groups (MSCGs).

Changed SAEs:

- **SAE 602, MCVLRD** (APT SAE)
  Stores the Location Area Identity (LAI) defined per cooperating VLR.
- SAE 603, MCVLRD (APT SAE)
  Stores the LAI digits used for defined LAIs.

OSS-RC 3 supports MSC Pool in GSM

The OSS-RC provides the following applications to support MSC in Pool:

Cell data configuration applications:

- The consistent configuration of the NRI length and NRI values in the MSC and the BSC nodes in the pool.
- Consistent cell data configuration in the pool (e.g. all MSC nodes in the pool have the same cell data).
- The configuration of the pool parameters in the BSC.

Performance management applications:

- NWSA core network reports are defined for the MSC pool according to the NWS reference (Network Statistics Analyzer, Function Description).
- GSM RAN reports aggregate and present BSC/cell performance data related to MSC nodes that belong to a MSC pool (data aggregation in reports but there is no counter aggregation in the database).

Fault management applications:

- A new object is available in FM for the MSC in pool. The FMX tool can be used to define rules to aggregate the MSC nodes alarms to the MSC pool object.

GSM Proxy Pool

The GSM MSC Pool Proxy feature makes it possible to build MSC Pools in networks where the Base Station Controllers don’t support the MSC Pool.

This feature is applied in the MGW nodes and in the MSC-S should support the MSC in Pool feature as well.

The MSC Pool concept is based on a load-sharing algorithm implemented in the BSCs. This algorithm will distribute the subscribers between MSC Servers in a pool at location updating with the purpose of loading the MSC Servers evenly, leading to significant cost savings and better ISP in the network. However, many non-Ericsson BSCs don’t support the algorithm in question. In this case, the GSM MSC Pool Proxy can handle the distribution of subscribers between MSC Servers according to the same standard algorithm as used in the BSCs.

GSM MSC Pool Proxies and BSCs supporting the load-sharing algorithm can be supported simultaneously in an MSC Pool.

Intentionally Blank

6 BSC/RNC Connection

Objectives

Demonstrate the BSC/RNC connection in the MSC-S BC.

- Write the BSC/RNC signaling data toward the Core Network.
- Create the BSC/RNC traffic route data toward the Core Network

Figure 6-1: Objectives

Intentionally Blank

INTRODUCTION

This chapter describes the configuration of the interface between the Core Network and the Radio Network Access nodes (BSC and RNC) in Mobile Softswitch Solution (MSS) or Layered Architecture (LA) Networks.

First, it the BSC connection will be presented and later on the RNC connection.

In Non-LA connection from MSC to BSC is called A interface and in the LA it is called Remote A interface as the BSC physical resources are connected in the MGW node but controlled by the MSC Server.

Both cases the protocol used for control plane is BSSAP.

As MSC-S Blade Cluster is only applied to LA networks, NLA is not show here.

The following diagram shows the network example:

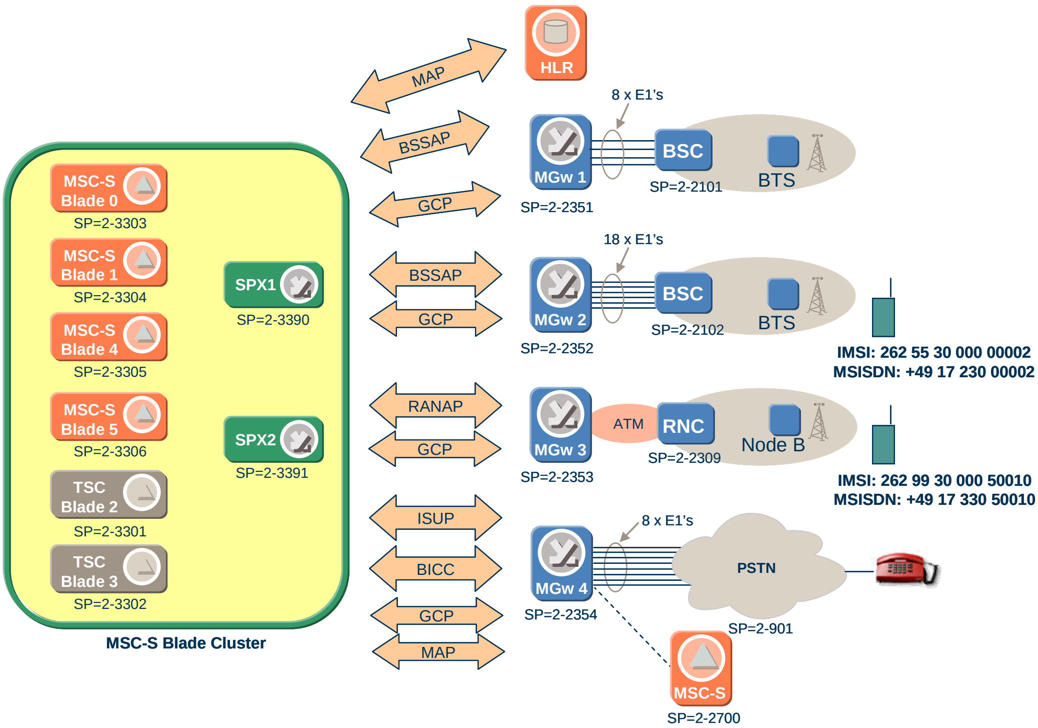


Figure 6-2: Network Diagram

ROUTES SUPPORTING BSSAP PROTOCOLS

The signaling protocol used towards the BSC is BSSAP. In NLA, BSC is connected directly to MSC via TDM (E1/T1) and just the same as those in prior releases, the device type is the MALT. In the MSC-S Blade Cluster, the remote A interface uses the MRALT device type.

The command MGBSI connects the BSC to the traffic routes.

Cell data is connected to BSC1 and BSC2 using command:

MGCEI:CELL =cell, CGI=cgi, BSC=bsc1;

MGCEI:CELL =cell, CGI=cgi, BSC=bsc2;

Cell Global Identity (CGI) defined as MCC+MNC+LAC+CI.

REMOTE A-INTERFACE

The M-MGW supports the Remote A-Interface in Layered Architecture Networks. This allows direct connection of the A-Interface to M-MGW instead of the MSC in Non-LA. The physical hardware belonging to the TDM termination group is controlled by the MSC-S Blade Cluster. In the M-MGW each E1/T1 circuit is defined as a TDM Termination Group with a specific PCM System number .The logical representation of these termination groups is defined in the MSC-S BC using MRALT devices: with corresponding circuit identification codes (CIC) and connected to one incoming and outgoing BSC route.

The block MRALT (Mobile Telephony Remote A-Interface Line Terminal) handles the maintenance and supervision of the TDM devices on the remote A-interface.

The block inter-works with 32 channel (E1) or 24 channel (T1) E-SNT's (external switching network terminal) of type RTDMA (remote TDM access).

To reuse existing configuration procedures the concept of the E-SNT was introduced before. An E-SNT is related to a group of devices, where the devices are physically connected to the M-MGW. From a Data Transcript point of view the configuration of the remote A interface is very similar to that of the A interface connected to the MSC in NLA.

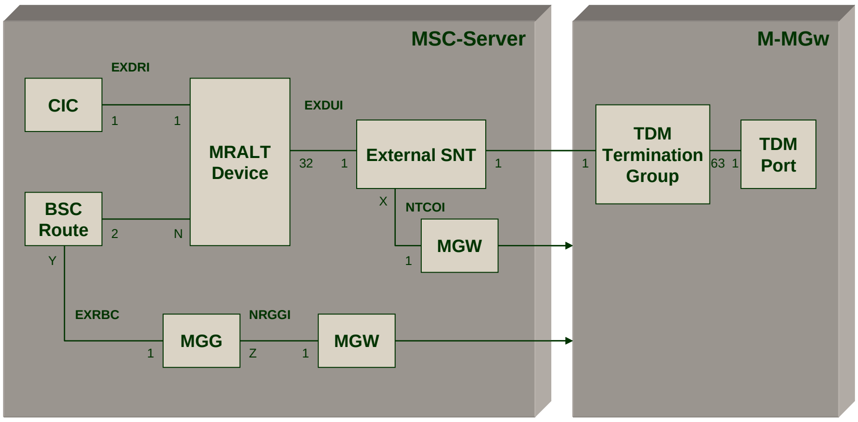


Figure 6-3: External –Switch Network Terminal

A one to one relationship exists between the E-SNT and the TDM Termination Group in the M-MGW. Different MSC-S cannot share the same TDM devices, this introduces the Virtual Media Gateway concept. A specific TDM Termination Group belongs to one V-MGW.

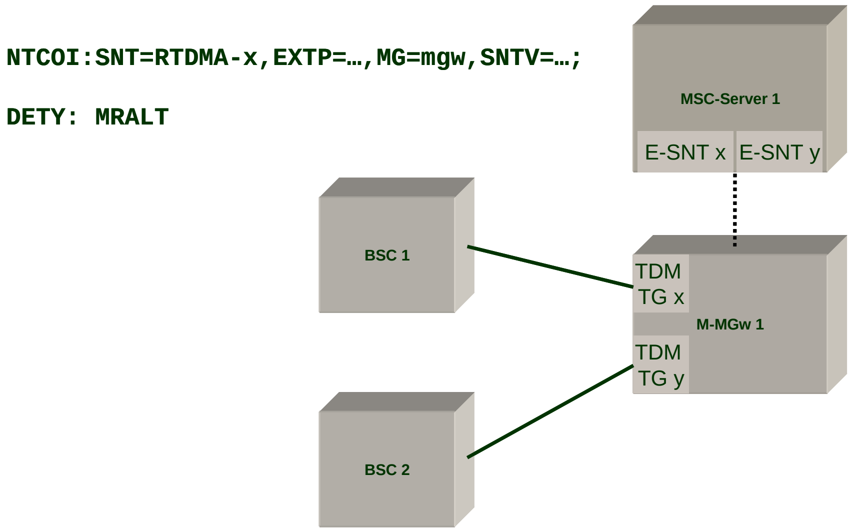


Figure 6-4: Remote A Interface

A TDM Termination Group contains 32/24 TDM terminations. Each termination has a unique 32- bit termination ID. The next figure shows a way to derive the device number from the Termination ID.

The Termination ID is for example received in a protocol analyzer trace.

The first step is to convert the Hexadecimal Termination ID to a binary value. The coding of a Termination ID is described in the upper left area of the following figure.

After identifying the bits used for the PCM System Number, the resulting value can be checked with the help of the NTCOP command.

Access (3 bits)	010 --> TDM
TDM Transport (3 bits)	010 --> E1, 001 -->T1
PCM System No. (21 bits)	e.g. Termination ID = H'4800 B015
Individual (5 bits)	

```
= 010  010  000000000010110000000  10101
  TDM  E1           1408            21
```

```
NTCOP:SNT=ALL;
SNT          SNTV   DEV                  EXTP          MG
  :
RTDMA-29     0      MRALT-160&&-191      2-2-1408      MGW1
  :
END
```

Figure 6-5: Termination ID Structure

The printout indicates MRALT (device 21) in this specific Termination Group and the M-MGW that contains the hardware.

BSC CONNECTED TO TWO MGW

The most important configuration steps for a BSC definition are listed.

The first step is to define an M-MGW and connect it to a restricted Media Gateway Group.

If redundancy is required, a second M-MGW has to be defined and connected to a second restricted Media Gateway Group.

To implement the redundancy feature, a third Media Gateway Group is defined which will contain the sum of the two previous M-MGW’s, this Media Gateway Group is non restricted.

The first route pair both incoming/outgoing routes of device type MRALT have to be defined and the restricted Media Gateway connected using EXRBC.

This is repeated for the second route pair.

The first route pair is connected to the BSC with command MGBSI.

The second route pair is connected to the BSC using command MGBWI.

The non restricted Media Gateway Group is then connected to the BSC with command MGBSC and parameter BSCMGG.

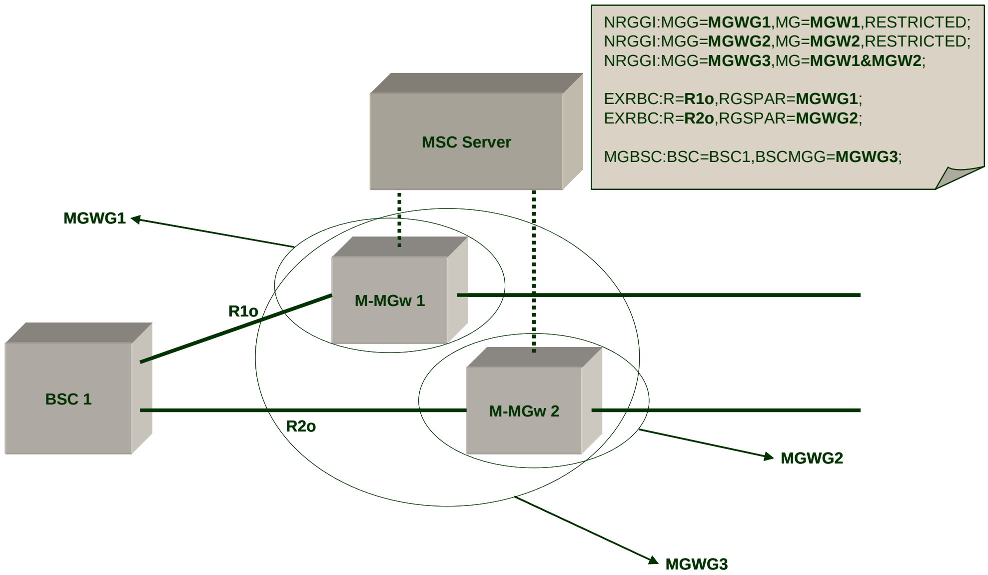


Figure 6-6: BSC Connected to Two M-MGW

If the BSC is connected redundantly) via two M-MGw's to the MSC Server, three MGGs have to be defined.

The restricted Media Gateway Groups MGWG1 and MGWG2 are connected to the outgoing BSC routes R1o and R2o. The non-restricted group MGWG3 includes both M-MGws and is connected to BSC1 using command MGBSC.

TDM Devices distribution

As every BSC served by the MSC Server Blade Cluster sees the cluster as a single node, the remote A-Interface routes to a given BSC must be defined consistently in every MSC blade. The A-interface traffic time slots are assigned by the MSC during traffic handling. These timeslots are identified by a unique CIC value per Signaling Point Code of the BSC.

An equal distribution of CICs (traffic time slots) must be achieved by manual administration. All MSC blades can handle the same capacity. It is not allowed to activate the same CIC for the same destination point code more then once inside the cluster. This must be as well assured by administration.

If this recommendation is not followed a call will fail when the same traffic time slot will be seized by another blade.

Basically the remote A-Interface configuration shall follow the ADI **Mobile Telephony Data: BSC and Remote A-interface Administration** if no circuit pools are used. If circuit pools are used the ADI **Mobile Telephony Data: BSC and Circuit Pool Administration for Remote A-interface**. Details about the command handing and further OPIs are referred and described in the ADI. However in the ADI only explains administration aspects from one MSC blade or non clustered MSC server point of view, specific MSC Server Blade Cluster aspects are not described in the documents.

Traffic measurements can be performed on a specific incoming external or outgoing route external or on a specific incoming and outgoing external route. Since outgoing external or incoming external routes might be located on different type of blades all A-Interface routes must be defined on TSC blades as dummy routes.

As discussed in the previous course, there is calculation that should be done depending on the amount of E1/T1 connected per BSC. The calculation itself is not shown here again but the DT example is detailed for both cases: regular and irregular distribution of MRALT devices.

DATA TRANSCRIPT FOR BSC

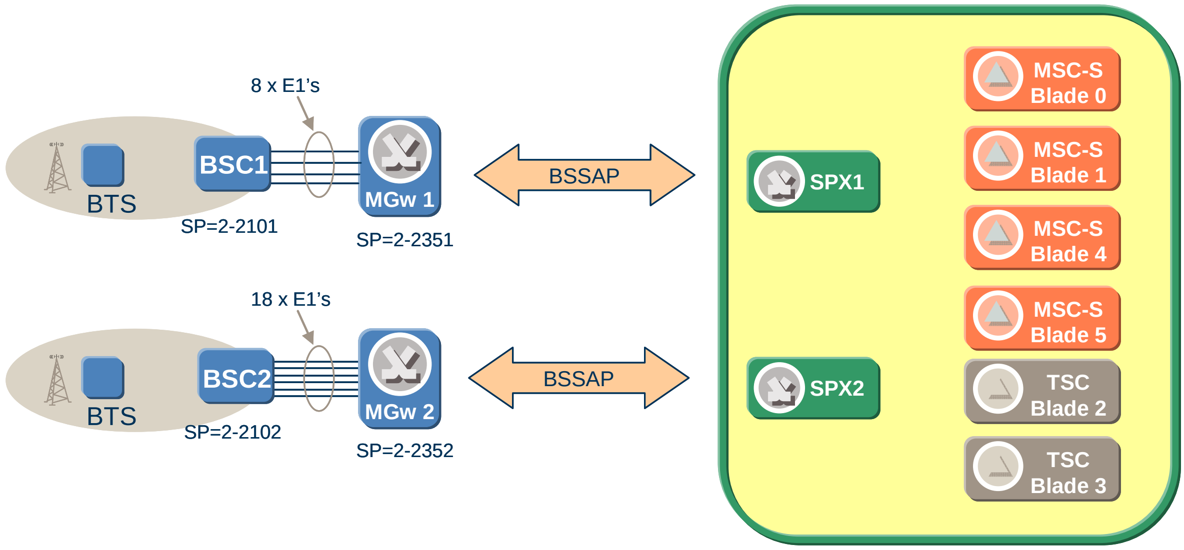


Figure 6-7: BSC Connection Network Example

Note that the main point here is the amount of E1/T1 trunks connected between BSCs and MGWs.

To define the route to BSCs, the EXROI command is used and to add the MGW node, EXRBC command using the parameter RGSPAR.

The non restricted Media Gateway Group is then connected to the BSC with command MGBSC and parameter BSCMGG.

- Common DT for all MSC blades;
  - Route definition

EXROI: R=BSC1O&BSC1I, DETY=MRALT, FNC=3, SI=SCCP, SP=2-2101;
EXRBC: R=BSC1O, RGSPAR=MGG-MGWG1;

  - BSC definition

MGBSI: BSC=BSC1, R1=BSC1O, R2=BSC1I;
MGBSC: BSC=BSC1, BSCMGG=MGWG1;

- Then, distribute all the timeslots per MSC blades. In this case:
  - 8 x 30 channels = 240 voice channels
  - 240 channels / 4 blades = 60 channels per blade
- Now, connect the amount of devices to external SNT.

Figure 6-8: Regular Distribution of MRALT Devices

Note that if the BSC1 is connected through two M-MGW then MGG would have both nodes i.e. it would include MGW1 and MGW2.

The concept of External Switching Network Terminals (E-SNT) is also applicable to remote ISUP and Chinese TUP devices.

The bearer setup direction is by default Backward Bearer Setup (not changeable).

- DT for MSC Blade0:

NTCOI:SNT=RTDMA-21,EXTP=2-2-910,SNTV=0,MG=MGW1;
NTCOI:SNT=RTDMA-22,EXTP=2-2-911,SNTV=0,MG=MGW1;
EXDUI:DEV=MRALT-0&&-31,SNT=RTDMA-21;
EXDUI:DEV=MRALT-32&&-63,SNT=RTDMA-22;

- DT for MSC Blade1:

NTCOI:SNT=RTDMA-21,EXTP=2-2-912,SNTV=0,MG=MGW1;
NTCOI:SNT=RTDMA-22,EXTP=2-2-913,SNTV=0,MG=MGW1;
EXDUI:DEV=MRALT-0&&-31,SNT=RTDMA-21;
EXDUI:DEV=MRALT-32&&-63,SNT=RTDMA-22;

…

- DT for MSC Blade5:

NTCOI:SNT=RTDMA-21,EXTP=2-2-916,SNTV=0,MG=MGW1;
NTCOI:SNT=RTDMA-22,EXTP=2-2-917,SNTV=0,MG=MGW1;
EXDUI:DEV=MRALT-0&&-31,SNT=RTDMA-21;
EXDUI:DEV=MRALT-32&&-63,SNT=RTDMA-22;

Figure 6-9. E-SNT Definition

- DT for MSC Blade0:
  EXDRI:R=BSC1O&BSC1I, DEV=MRALT- 2 &&- 31, MISC1=**2** ;
  EXDRI:R=BSC1O&BSC1I, DEV=MRALT- 34 &&- 63, MISC1=**34** ;

- DT for MSC Blade1:
  EXDRI:R=BSC1O&BSC1I, DEV=MRALT- 2 &&- 31, MISC1=**66** ;
  EXDRI:R=BSC1O&BSC1I, DEV=MRALT- 34 &&- 63, MISC1=**98** ;

- DT for MSC Blade4:
  EXDRI:R=BSC1O&BSC1I, DEV=MRALT- 2 &&- 31, MISC1=**130**;
  EXDRI:R=BSC1O&BSC1I, DEV=MRALT- 34 &&- 63, MISC1=**162** ;

- DT for MSC Blade5:
  EXDRI:R=BSC1O&BSC1I, DEV=MRALT- 2 &&- 31, MISC1=**194**;
  EXDRI:R=BSC1O&BSC1I, DEV=MRALT- 34 &&- 63, MISC1=**226**;

- Common for all MSC Blades:
  NTBLE… BLORE… EXDAI… BLODE….

Figure 6-10: Devices Connection

Here is shown the signaling definition necessary in the SPX nodes.

All the signaling necessary in the BSCs, regarding SUA protocol for example was defined in the Signaling in MSC-S BC chapter.

- Common DT for SPX nodes
  C7SPP:SP=2-2101;
  C7SPI:SP=2-2101 ,OWNSP=<SPX>;
  C7PNC:SP=2-2101 ,SPID=BSC1;
  C7NPI:SP=2-2101;
  C7NPC:SP=2-2101 ,MSG=1,MTC=1, HPCCON; !Towards to BSC!
  C7HPI:HPC=2-2000; !Towards to MSC Blades!

  IHBII:LIP="<IP1>"&"<IP2>",EPID=EP1,USER=M3UA;
  IHADI:SAID=ASSOC1, EPID=EP1, RIP="<MGwIP1>"&"<MGwIP2>", SCTPCP;
  IHASC:SAID=ASSOC1, PROC=ESTB, USER=M3UA, SCTPCP;
  M3ASC:SAID=ASSOC1, PROC=ACT;
  M3RSI:DEST=2-2101, SAID=ASSOC1, PRIO=1, BMODE=PEER;
  M3RAI:DEST=2-2101, SAID=ASSOC1;

- DT for TSC blades
  - No definition is needed in these blades.

Figure 6-11. Signaling Definition in SPXes

As the BSC2 has different amount of E1/T1 trunks connected to MGW (another MGW as well in this case), the DT is also shown here.

Note that the amount of traffic timeslots per blade is different and the blades are sharing the control of some E1s.

- Common DT for all MSC blades;
  - Route definition

EXROI: R=**BSC2O**&**BSC2I**, DETY=MRALT, FNC=3, SI=SCCP, SP=**2-2102**;
EXRBC: R=**BSC2O**, RGSPAR=MGG-**MGWG2**;

  - BSC definition

MGBSI: BSC=**BSC2**, R1=**BSC2O**, R2=**BSC2I**;
MGBSC: BSC=BSC2, BSCMGG=MGWG2;

- Then, distribute all the timeslots per MSC blades. In this case:
  - 18 x 30 channels = 540 voice channels
  - 540 channels / 4 blades = 135 channels per blade

- Note that 135 channels represent 4,5 E1s. Connect the amount of devices to external SNT.

Figure 6-12. Irregular Distribution of MRALT Devices

From the E-SNT point of view, all the timeslots in the 5th trunk are connected using the EXDUI command.

All SNT names can be the same in all MSC blades, but the external point connection in the MGW node (EXTP parameter) must be different as it represents a single PCM system number in the MGW node.

- DT for MSC Blade0:

NTCOI:SNT=RTDMA-31,EXTP=2-2-1031,SNTV=0,MG=MGW2;
NTCOI:SNT=RTDMA-32,EXTP=2-2-1032,SNTV=0,MG=MGW2;
NTCOI:SNT=RTDMA-33,EXTP=2-2-1033,SNTV=0,MG=MGW2;
NTCOI:SNT=RTDMA-34,EXTP=2-2-1034,SNTV=0,MG=MGW2;
NTCOI:SNT=RTDMA-35,EXTP=2-2-1035,SNTV=0,MG=MGW2;
EXDUI:DEV=MRALT-0&&-31,SNT=RTDMA-31;
EXDUI:DEV=MRALT-32&&-63,SNT=RTDMA-32;
EXDUI:DEV=MRALT-64&&-95,SNT=RTDMA-33;
EXDUI:DEV=MRALT-96&&-127,SNT=RTDMA-34;
EXDUI:DEV=MRALT-128&&-159,SNT=RTDMA-35;

- DT for MSC Blade1:

NTCOI:SNT=RTDMA-31,EXTP=2-2-**1036**,SNTV=0,MG=MGW2;
NTCOI:SNT=RTDMA-32,EXTP=2-2-**1037**,SNTV=0,MG=MGW2;
NTCOI:SNT=RTDMA-33,EXTP=2-2-**1038**,SNTV=0,MG=MGW2;
NTCOI:SNT=RTDMA-34,EXTP=2-2-**1039**,SNTV=0,MG=MGW2;
NTCOI:SNT=RTDMA-35,EXTP=2-2-**1040**,SNTV=0,MG=MGW2;
EXDUI:DEV=MRALT-0&&-31,SNT=RTDMA-31;
EXDUI:DEV=MRALT-32&&-63,SNT=RTDMA-32;
EXDUI:DEV=MRALT-64&&-95,SNT=RTDMA-33;
EXDUI:DEV=MRALT-96&&-127,SNT=RTDMA-34;
EXDUI:DEV=MRALT-128&&-159,SNT=RTDMA-35;

Figure 6-13. E-SNT Definition

- DT for MSC Blade4:
  NTCOI:SNT=RTDMA-31,EXTP=2-2-**1041**,SNTV=0,MG=MGW2;
  NTCOI:SNT=RTDMA-32,EXTP=2-2-**1042**,SNTV=0,MG=MGW2;
  NTCOI:SNT=RTDMA-33,EXTP=2-2-**1043**,SNTV=0,MG=MGW2;
  NTCOI:SNT=RTDMA-34,EXTP=2-2-**1044**,SNTV=0,MG=MGW2;
  NTCOI:SNT=RTDMA-35,EXTP=2-2-**1045**,SNTV=0,MG=MGW2;
  EXDUI:DEV=MRALT-0&&-31,SNT=RTDMA-31;
  EXDUI:DEV=MRALT-32&&-63,SNT=RTDMA-32;
  EXDUI:DEV=MRALT-64&&-95,SNT=RTDMA-33;
  EXDUI:DEV=MRALT-96&&-127,SNT=RTDMA-34;
  EXDUI:DEV=MRALT-128&&-159,SNT=RTDMA-35;

- DT for MSC Blade5:
  NTCOI:SNT=RTDMA-31,EXTP=2-2-**1046**,SNTV=0,MG=MGW2;
  NTCOI:SNT=RTDMA-32,EXTP=2-2-**1047**,SNTV=0,MG=MGW2;
  NTCOI:SNT=RTDMA-33,EXTP=2-2-**1048**,SNTV=0,MG=MGW2;
  NTCOI:SNT=RTDMA-34,EXTP=2-2-**1049**,SNTV=0,MG=MGW2;
  NTCOI:SNT=RTDMA-35,EXTP=2-2-**1050**,SNTV=0,MG=MGW2;
  EXDUI:DEV=MRALT-0&&-31,SNT=RTDMA-31;
  EXDUI:DEV=MRALT-32&&-63,SNT=RTDMA-32;
  EXDUI:DEV=MRALT-64&&-95,SNT=RTDMA-33;
  EXDUI:DEV=MRALT-96&&-127,SNT=RTDMA-34;
  EXDUI:DEV=MRALT-128&&-159,SNT=RTDMA-35;

Figure 6-14. E-SNT Definition (cont.).

The devices are connected to BSC2 traffic route by using the EXDRI command. The parameter MISC1 represents the CIC value. As from BSC2 sees the MSC-S BC as a unique node, the CIC values should be equally distribute per blades. In the example, if we separate the timeslot 1 of each E1 for signaling purpose, 135 traffic channels (CICs) will be controlled by each MSC blade.

The CIC values will be sequentially considering all blades. The MRALT devices could be the same if it is not representing the shared trunk. The MSC-S nodes cannot control the same PCM system number. So for the same E1/T1 when shared by different MSC blades, it should be defined another PCM system number (in the MGW) and another EXTP in the MSC Blade.

The DT below shows that part of the E1 (devices from MRALT 130 &&-144) is controlled by MSC Blade 0 and the other half (MRALT 145&&- 159) is controlled by MSC Blade 1.

As MSC Blade 1 is another “node”, it can reuse the MRALT device numbers to represent another E1 in the A-interface. It could be use another range to make an easier comprehension but in this case the SAEs in all Blades should be much bigger and it will be useless.

- DT for MSC Blade0:
  EXDRI:R=BSC1O&BSC1I, DEV=MRALT- 2 &&- 31, MISC1=**2** ;
  EXDRI:R=BSC1O&BSC1I, DEV=MRALT- 34 &&- 63 , MISC1=**34** ;
  EXDRI:R=BSC1O&BSC1I, DEV=MRALT- 66 &&- 95 , MISC1=**66** ;
  EXDRI:R=BSC1O&BSC1I, DEV=MRALT- 98 &&- 127, MISC1=**98** ;
  EXDRI:R=BSC1O&BSC1I, DEV=MRALT-130&&- 144, MISC1=**130** ;

- DT for MSC Blade1:
  EXDRI:R=BSC1O&BSC1I, DEV=MRALT-145 &&-159, MISC1=**145** ;
  EXDRI:R=BSC1O&BSC1I, DEV=MRALT- 2 &&- 31, MISC1=**162** ;
  EXDRI:R=BSC1O&BSC1I, DEV=MRALT- 34 &&- 63 , MISC1=**194** ;
  EXDRI:R=BSC1O&BSC1I, DEV=MRALT- 66 &&- 95 , MISC1=**226** ;
  EXDRI:R=BSC1O&BSC1I, DEV=MRALT- 98 &&- 127, MISC1=**258** ;

- DT for MSC Blade4:
  EXDRI:R=BSC1O&BSC1I, DEV=MRALT- 2 &&- 31, MISC1=**290** ;
  EXDRI:R=BSC1O&BSC1I, DEV=MRALT- 34 &&- 63 , MISC1=**322** ;
  EXDRI:R=BSC1O&BSC1I, DEV=MRALT- 66 &&- 95 , MISC1=**354** ;
  EXDRI:R=BSC1O&BSC1I, DEV=MRALT- 98 &&- 127, MISC1=**386**;
  EXDRI:R=BSC1O&BSC1I, DEV=MRALT-130&&- 144, MISC1=**418** ;

Figure 6-15. Device connection

- DT for MSC Blade5:
  EXDRI:R=BSC1O&BSC1I, DEV=MRALT-145 &&-159, MISC1=**433** ;
  EXDRI:R=BSC1O&BSC1I, DEV=MRALT- 2 &&- 31, MISC1=**450** ;
  EXDRI:R=BSC1O&BSC1I, DEV=MRALT- 34 &&- 63 , MISC1=**482** ;
  EXDRI:R=BSC1O&BSC1I, DEV=MRALT- 66 &&- 95 , MISC1=**514** ;
  EXDRI:R=BSC1O&BSC1I, DEV=MRALT- 98 &&- 127, MISC1=**546** ;

- Common for all MSC Blades:
  NTBLE… BLORE… EXDAI… BLODE….

Figure 6-16. Device connection (cont.)

Below, again the definition in the SPXes regarding signaling to BSC2.

- Common DT for SPX nodes
  C7SPP:SP=2-2102;
  C7SPI:SP=2-2102 ,OWNSP=<SPX>;
  C7PNC:SP=2-2102 ,SPID=BSC2;
  C7NPI:SP=2-2102;
  C7NPC:SP=2-2102 ,MSG=1,MTC=1, HPCCON;

  IHBII:LIP="<IP1>"&"<IP2>",EPID=EP1,USER=M3UA;
  IHADI:SAID=ASSOC2, EPID=EP1, RIP="<MGw2IP1>"&"<MGw2IP2>", SCTPCP;
  IHASC:SAID=ASSOC2, PROC=ESTB, USER=M3UA, SCTPCP;
  M3ASC:SAID=ASSOC2, PROC=ACT;
  M3RSI:DEST=2-2102, SAID=ASSOC2, PRIO=1, BMODE=PEER;
  M3RAI:DEST=2-2102, SAID=ASSOC2;

- DT for TSC blades
  – No definition is needed in these blades.

Figure 6-17. Signaling definition in SPXes

BSC Redundant Connection

In the case of alternative and additional routes, the commands **MGBWI** and **MGBOI** are used to connect outgoing and incoming Media Gateway routes to a BSC. Additional routes can only be connected with command **MGBOI** if a route pair with the same media gateway group is already connected to the same BSC.

- Connect additional outgoing and incoming M-MGw routes pairs to an BSC:

  `MGBOI:BSC=bsc,R1=r1,R2=r2;`

  (Additional routes can only be connected to the BSC if a route pair with the same media gateway group is already connected to the same BSC)

- Connect alternative outgoing and incoming M-MGw routes to an BSC:

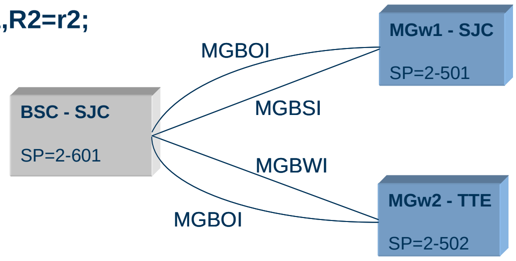
  `MGBWI:BSC=bsc,R1=r1,R2=r2;`

  (no route pair is connected to the BSC towards the M-MGw)

The first route pair is connected when the BSC is defined (MGBSI).

- Connect alternative outgoing and incoming M-MGw routes to an BSC:
  MGBWI:BSC=BSC1,R1=BSJC2o,R2=BSJC2i

- Connect additional outgoing and incoming M-MGw routes pairs to an BSC:
  MGBOI:BSC=bsc,R1=r1,R2=r2;



See AI: MRCIPOA

Figure 6-18: Connection of Additional & Alternative Routes to BSC

Bearer Setup Direction

For BSCs the bearer setup direction definition is **not** defined as a parameter connected to routes using command EXRBC. Instead it is defined as a BSC capability (PBSD), which can be set with the command MGBSC.

- Definition of Bearer Setup Direction:
  MGBSC:BSC=BSC1,PBSD=FORWD;

  The parameter PBSD can be either:
  - BACKD
    Backward bearer set up direction preferred
  - FORWD
    Forward bearer set up direction preferred

Figure 6-19: Bearer Setup Direction

Connection of Transcoders

Transcoders are required to change the coding of the speech to be transmitted over the air interface. The most common types of coding exist: Full Rate (FR), Half Rate (HR) and Enhanced Full Rate (EFR).

Traditionally, the transcoders have been controlled by the BSC. However, the Transcoders can be configured as a standalone node (TRC), placed on the A-Interface (Non-LA networks) or remote A-Interface (LA networks), but not under the BSC control.

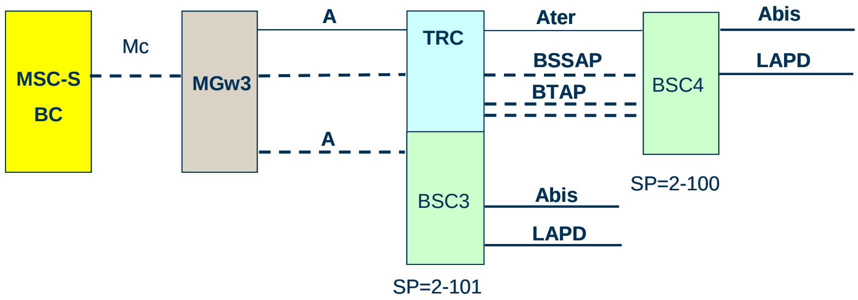


Figure 6-20: Combined TRC/BSC and standalone BSC

Where the standalone TRC is utilized a new interface, the Ater is introduced between BSC and TRC. Up to 15 BSC's can be connected to 1 TRC.

- ROUTES TOWARDS THE BSC4:

```
EXROI:R=BSC4O&BSC4I, DETY=MRALT, FNC=3, SI=SCCP, SP=2-100;
!EXRBC:R=BSC4O&BSC4I, RNO=1, MIS1=1, MIS2=1;
!Pool no. 1 & Full Rate!

EXROI:R=BSC4HRO&BSC4HRI, DETY=MRALT, FNC=3, SI=SCCP, SP=2-100;
!EXRBC:R=BSC4HRO&BSC4HRI, RNO=1, MIS1=2, MIS2=2;
!Pool no. 2 & Half Rate!

EXROI:R=BSC4ERO&BSC4ERI, DETY=MRALT, FNC=3, SI=SCCP, SP=2-100;
!EXRBC:R=BSC4ERO&BSC4ERI,RNO=1,MIS1=3,MIS2=4;
!Pool no3 & Enhanced Full Rate!

EXROI:R=BSC4SO&BSC4SI, DETY=MRALT, FNC=5;
```

Figure 6-21: Circuit Pool Handling Towards BSC

- BSC Definition:

  MGBSI:BSC=BSC4, R1=BSC4O, R2=BSC4I;
  MGBSC:BSC=BSC4, BSCDATA=HRATE-1;
  MGBSC:BSC=BSC4, BSCDATA=NIRR-1;
  MGBSC:BSC=BSC4, BSCDATA=MSCODER-1;
  MGBSC:BSC=BSC4, BSCMGG=MGWG4;

- Devices connection:

  EXDRI:R=BSC4O&BSC4I, DEV=MRALT-2&&-31, MISC1=2;
  EXDRI:R=BSC4HRO&BSC4HRI, DEV=MRALT-34&&-63, MISC1=2;
  EXDRI:R=BSC4ERO&BSC4ERI, DEV=MRALT-66&&-95, MISC1=2
  EXDRI:R=BSC4SO&BSC4SI, DEV=MRALT-1&-33&-65;

Figure 6-22: Circuit Pool Handling Towards BSC (cont.)

It can be seen from Figure above that three traffic routes are defined towards BSC4, one route supporting Full Rate, the second supporting Half Rate and the third supporting Enhanced Full Rate. This can be determined with the MIS2 parameter. Use the AI for MRALT. Each one of these routes is termed as a POOL and requires a unique number. The MIS1 parameter gives the Pool Number. Parameter RNO is an NMS function and would be used as a network Management function.

Transcoder of type R6A is housed in the GEM magazine on the Common Speech Processor Board and will support TFO (Tandem Free Operation). In case MSS networks, the TRA are in the MGW nodes.

UTRAN INTRODUCTION

UTRAN CONCEPT

The WCDMA Radio Access Network (RAN) consists of Radio Network Controllers (RNC), Radio Base Stations (RBS), the OSS-RC and Tools for Radio Access Management (TRAM). RBS corresponds to Node B in the 3GPP specifications. Figure 6-2 shows a complete RAN system concept.

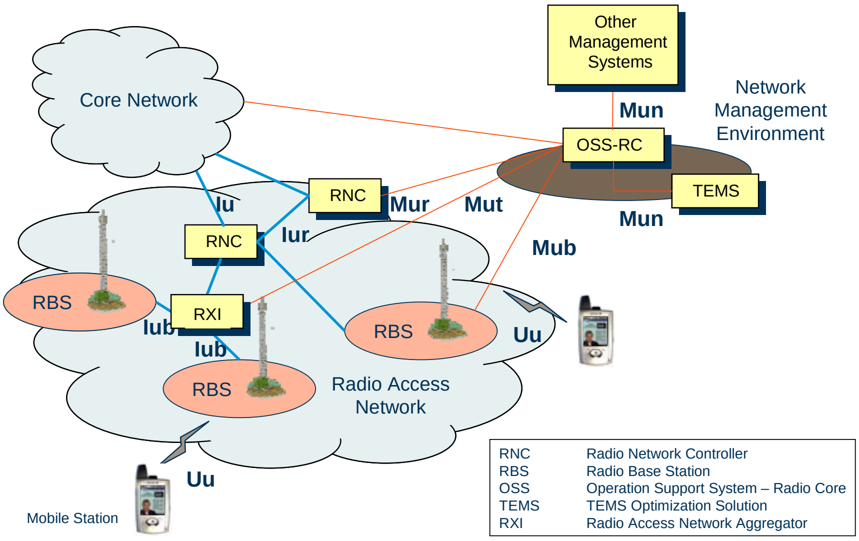


Figure 6-23: WCDMA RAN Basic Architecture

The WCDMA RAN comprises Radio Network Controllers (RNCs) and Radio Base Stations (RBSs) built on the Connectivity Packet Platform (CPP).

The main tasks of the RNC are to manage the Radio Access Bearers for user data transport, manage and optimize the radio network resources and control the mobility, while RBS provides the actual radio resources and maintains the radio links.

To enable communication between the different Network Elements (NEs) in the WCDMA RAN and between the WCDMA RAN and the Core Network, different interfaces are defined and used. Over the interfaces, transport of signaling and user data is performed via a Transport Network Infrastructure using ATM or IP.

RNC is connected to the core network via the Iu interface and the User Equipment (UE) is connected to RBS via the Uu interface (the radio interface). Internally within RAN, the RNCs are interconnected via the Iur interface and the RBSs to the RNC via the Iub interface.

OSS-RC is a set of software for handling operation and maintenance tasks for the WCDMA RAN. RANOS gives a consolidated view of the RAN information such as alarms, configurations and basic performance. It also provides several interfaces for easy integration with the existing management environment.

The Tools for Radio Access Management (TRAM) gives support for planning, test and performance monitoring of the radio- and the transport network. The resulting configuration data from the TRAM design can, via RANOS, be downloaded to the nodes.

IU INTERFACE

Iu is the interface between the WCDMA RAN and Core Network. The Iu interface connects the RNC (via the MGW) to the MSC-Blade Cluster and the SGSN. The interface is therefore divided into two parts:

- The Iu interface to the packet switched domain, i.e. to the SGSN, is referred to as Iu-PS.
- The Iu interface to the circuit switched domain, i.e. to the MSC-S BC, is referred to as Iu-CS.

The Iu interface supports several functions such as establishing, maintaining and releasing Radio Access Bearers (RABs), performing intra-system and intersystem handover, and location services by transferring requests from the CN to WCDMA RAN, and location information from WCDMA to CN.

Radio Access Network Application Part (RANAP) is the protocol used over the Iu interface. The signaling transport can be either ATM or IP.

Traffic circuit switched and packet switched is transported over ATM or IP.

SIGNALING TRANSPORT TO RNC

In MSC-S Blade Cluster is possible to connect the RNC (via MGW) using IP or ATM. IP is a basic option and ATM is an optional.

CONNECT RNC TO MSC SERVER

In the following example the definitions are shown to connect an MSC-S Blade Cluster node via MGW with an RNC as shown in figure below:

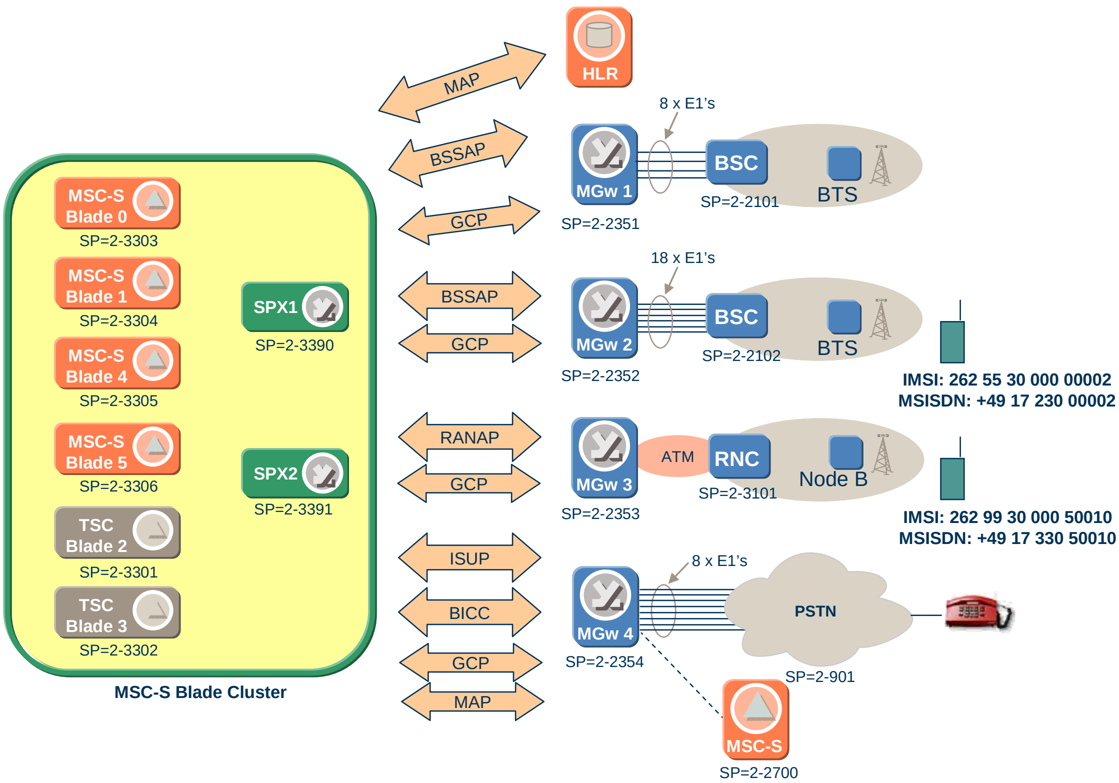


Figure 6-24: MSC-S BC RNC Connection

IU-INTERFACE

Every RNC served by the MSC Server Blade Cluster sees the cluster as a single node, the Iu-interface routes to a given destination must be defined consistently in every MSC blade. As the MSC Server Blade Cluster will have a single Signaling Point Code visible for the RAN, the signaling connection to RNCs must be done thru the signaling proxy.

Basically the Iu-Interface shall follow the ADI **'Mobile Telephony Data: Radio network Controller'**.

There is no specific administration aspects from one MSC Server Blade Cluster compared to classic MSC Server beside the fact that all data that belong to an RNC must be consistently setup on each MSC blades. This applies also for changes in the RNC configuration as well as for a removal of an RNC.

The used resources in MGW to transport the traffic payload can be dynamically allocated to each MSC blade. There is no complicated manual distribution of “circuits” necessary for the Iu interface.

Whenever new RNC routes are added dummy routes might be defined in the TSC blades using command EXROI with the same route name as defined previously in the MSC blades but using device type TRDRN.

Inter MSC Handover and SRNS reallocation

The E-interface has to be setup between the MSC Blades and the neighbor MSC nodes where Inter MSC Handover and SRNS reallocation shall be possible. Handover and SRNS reallocation between blades within the MSC-S BC must be not configured.

RNC DT DEFINTION IN MSC-S BLADE CLUSTER

Follow the DT to define the RNC node in the MSC-S BC.

The SUA signaling is shown below in the MSC Blades. In the TSC Blades there is no signaling definition regarding RNC. Only dummy routes.

The SPX nodes are responsible to establish the signaling connection towards RNC, i.e. the SCTP associations, M3UA routing tables and so on. The signaling transport is described in more details in the Signaling in MSC-S BC chapter.

Common DT for all MSC Blades:

- ### Signaling Definition

  UANPI:SP=2-3101,ASSP=2-3300;
  UANPC:SP=2-3101,SPIDNT=RNC3101;
  UANSI:SP=2-3101,SSN=142;

- ### Route Definition

  EXROI:R=RNC1o&RNC1i, DETY=MUIUCM, SI=SCCP, SP=2-3101, FNC=3;
  EXRBC:R=RNC1i, RGSPAR=MGG-MGWG3;
  EXRBC:R=RNC1o, RGSPAR=MGG-MGWG3;

Figure 6-25: RNC Signaling and Route Definition

Not all the SUA signaling definition is show here as it was defined in the Signaling Chapter. For more information check the Signaling chapter for ASP, SGP definitions.

RNC Signaling in the SPX nodes:

- Destination Point code (RNC):
  C7SPI:SP=2-3101,OWNSP=<ownsp>,NET=IP;
  C7PNC:SP=2-3101,SPID=RNC1;

- Cooperating SP in the SCCP level:
  C7NPI:SP=2-3101;

- Hosted Point Code Connection required:
  C7NPC:SP=2-3101, MSG=1, MTC=1, HPCCON; !Towards RNC!
  C7HPI:SP=2-3300; !Towards MSC Blades!

- M3UA Routing Table:
  M3RSI:DEST=2-3101,SAID=ERAMGW3101,PRIO=1,BMODE=PEER;
  M3RAI:DEST=2-3101,SAID=ERAMGW3101;

Figure 6-26: RNC Signaling and Route Definition (cont.)

Common DT for all MSC Blades:

- LAI Definition
  MGLAI:LAI=240-99-3101;
  MGLAC :LAI=240-99-3101, PFC=ON;

- RNC Definition
  MGRII:RNC=RNC3101, RNCID=240-99-3101, R1=RNC1o, R2=RNC1i;

- Paging Area:
  MGMAI:RNC=RNC3101,LAI=240-99-3101;

Figure 6-27: RNC Location and Paging Area

Common DT for all MSC Blades:

- Area Cluster Definition:
  MGAAI:AREA=3101A, SAI=240-99-3101-01;
  MGAAI:AREA=3101B, SAI=240-99-3101-02;
  MGAAI:AREA=3101C, SAI=240-99-3101-03;
  MGAAC:AREA=3101A,RO=1, CO=5, EO=1;
  MGAAC:AREA=3101B,RO=1, CO=5, EO=1;
  MGAAC:AREA=3101C,RO=1, CO=5, EO=1;

- RNC Location Number:
  MGLCI:AREA=3101A, LOCNO=4-491723101;

- Outer RNC Initiate:
  MGORI:RNC=RNC6101, RNCID=240-99-6101, MSC=MSC4;
  MGORI:RNC=RNC6102, RNCID=240-99-6102, MSC=MSC4;
  MGORI:RNC=RNC9101, RNCID=240-99-9101, MSC=MSC5;

Figure 6-28: RNC Area Cluster and Location Number

First, a route must be defined for cell analysis from the MSC to the RNC, the Device Type (DETY) is MUIUCM and the Service Indicator (SI) is SCCP.

MGRII is used to connect the incoming and outgoing traffic routes to the RNC, RNCID means the RNC Identity which is composed of Mobile Country Code (MCC), Mobile Network Code (MNC) and RNC number (RNCNO). R1, R2 are the outgoing and incoming traffic route associated with the RNC.

Then, the definition and the connection of a location area in the MSC are supposed to be done by using MGLAI.

MGMAI is used to define a connection between a LAI and a RNC. This connection is needed for paging purposes (It defines a paging area).

Then, an area cluster has to be defined with MGAAI. An area cluster can have one or more SAIs, LAIs or PLMNs connected to it. Data such as RO, CO, EA can be connected to an area cluster with MGAAC.

It can be assigned a location number to a specific area cluster by using the command MGLCI.

The outer RNC represents the neighbors' access nodes. They are defined using the command MGORI. Also the MGNMI and MGCVI to define the MSC which controls the correspondent RNC is defined previously.

APPENDIX

ASYNCHRONOUS TRANSFER MODE (ATM)

The WCDMA network must be able to offer today's range of services as well as services with new features, for example high bit rates (more than 2 Mbps). The requirements of modern networking involve

- Handling multiple types of traffic.
- Reliability and flexibility of the communications links.

Voice, video and data traffic all have individual characteristics. These multiple types of traffic make very different demands on the communications channel and these demands can sometimes be completely opposed to each other. The biggest problem is that transmissions occur at statistically random intervals.

If we want to combine data, voice and video on the same links, the solution is to use ATM with fixed and relatively short packets so that the delays produced by each packet is short and probably fixed. ATM is a transmission technology that uses fixed-size packets called cells. A cell is a 53 bytes packet with 5 bytes of header/ descriptor and 48 bytes of payload, or user traffic - voice, data, or video.

In the WCDMA, ATM links are used between RBS and RNC, and between MSC Server and RNC.

THE ATM CELL

ATM is a packet mode technique, but the delay in the network can be kept to a minimum because the cells have a fixed length. The format of an ATM cell is described in Figure 6-4.

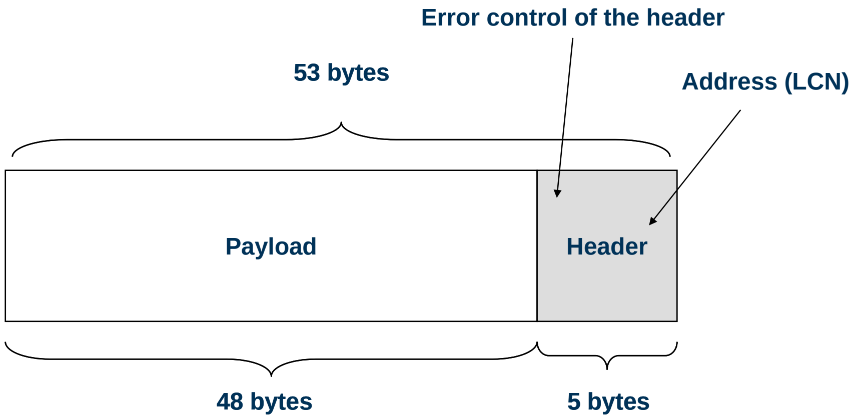


Figure 6-29: Format of the ATM cell

The most important field in cell header is the address field. It identifies the circuit and provides a unique link address between two network nodes in the form of a logical channel number (LCN).

The logical channel number is identified by:

- The Virtual Path Identifier (VPI, 8 or 12 bits).
- The Virtual Channel Identifier (VCI, 16 bits).

The header also contains, as shown in Figure 6-5,

- Header Error Control (HEC, 8 bits).
- Payload Type Identifier (PTI, 3 bits).
- Cell Loss Priority (CLP, 1 bit).

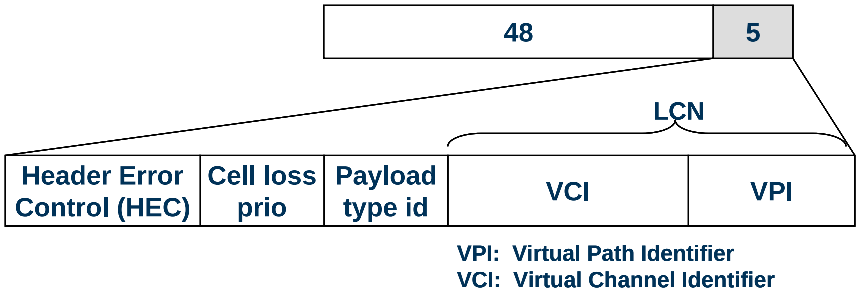


Figure 6-30: The Contents of an ATM Cell Header

THE PRINCIPLE OF ATM SWITCHING

In an ATM switch, ATM cells are transported from an incoming logical channel to one or more outgoing logical channels. A logical channel is indicated by a combination of two identities:

1. The identity of the physical link

2. The identity of the channel on the physical link. The identity of the channel is made up of the Virtual Path Identifier (VPI) and the Virtual Channel Identifier (VCI)

The switching of cells through an ATM node requires a relation between the identities of incoming and outgoing logical channels on the physical links between nodes. In Figure 6-6 the principle of ATM switching is shown. The values in the cell header specify the logical channel number (VPI and VCI). In this example the routing table is set up so that incoming ATM cells on link 1, VPI=1, VCI=33 are switched to link 3, VPI=1, VCI=125.

Link in	VPI	VCI	Link out	VPI	VCI
1	1	33	3	1	125
1	1	124	3	1	126
2	5	226	3	1	127

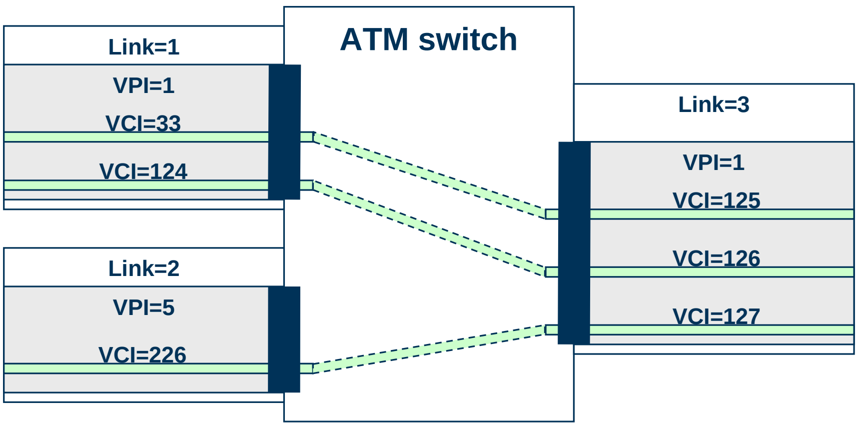


Figure 6-31: The Principle of ATM Switching

CLASSIFICATION OF SERVICES

The ITU-T has standardized a protocol reference model for ATM, which shows similarities with the OSI model. The three lowest layers in the protocol reference model are:

- Layer 1 - the physical layer.
- Layer 2 - the ATM layer.
- Layer 3 - the AAL layer.

To enable transfer of both data and isochronous services (delay sensitive like speech), the information must be adapted to the network in different ways. ATM has been divided into four service classes (A, B, C and D) on the basis of three parameters. Four protocols (AAL 1, AAL 2, AAL 3/4 and AAL 5) are defined for each one of the classes. See Figure 6-7.

Service class	Class A	Class B	Class C	Class D
AAL type	AAL1	AAL2	AAL3/4 AAL5	AAL3/4 AAL5
Service type	Isochronous	Isochronous	Asynchronous	Asynchronous
Bit rate	Constant	Variable	Variable	Variable
Examples	Telephony	Video 3G mobile	Connection oriented (FR)	Connection less (IP)

Figure 6-32: ATM Adaptation Layers &Classes

In the WCDMA, we use AAL2 for speech traffic between the MSC/MGW and RNC in Monolithic Architecture and we use AAL2 for speech traffic between the MSC Server and RNC in Layered Architecture. We use AAL5 for data traffic between the SGSN and RNC. We also use AAL5 for signaling between the MSC Server/SGSN and RNC.

ATM LINK INTERFACE ENHANCED (ALI-E)

The ATM Link Interface Enhanced (ALI-E) is an interface for ATM inter-working in AXE nodes. ALI-E gives ATM termination capabilities in AXE for both user plane and control plane offering combined, reliable, and powerful signaling terminal and exchange terminal functions. ALI-E is based on GEM (Generic Ericsson Magazine) mechanics and includes support for RPB-E (Ethernet based) communication with CP. That represents an enhancement of previous version of ATM termination based on GDM mechanics (ALI), giving better performances in terms of traffic and signaling capacity.

ALI-E operates at 155 Mbit/s and terminates STM-1/VC-4 (or STS-3c/SPE), ATM/AAL2 and ATM/SAAL.

ALI-E has a hardware implementation consisting of a single board Plug In Unit (PIU) compatible to the GEM.

The board implements the ALI-E functionality:

- SDH/SONET termination
- ATM layer termination
- AAL2 & AAL5 functions, housed on FPGA
- RP_ALI block including:
    1. DL34 interface and RPB-S bridge
    2. System controller
    3. Processor (PowerPC750FX)
    4. Ethernet interfaces
- POWER block
- CLOCK synchronization and distribution block

The ALI-E Plug-In-Unit is shown in the following figure.

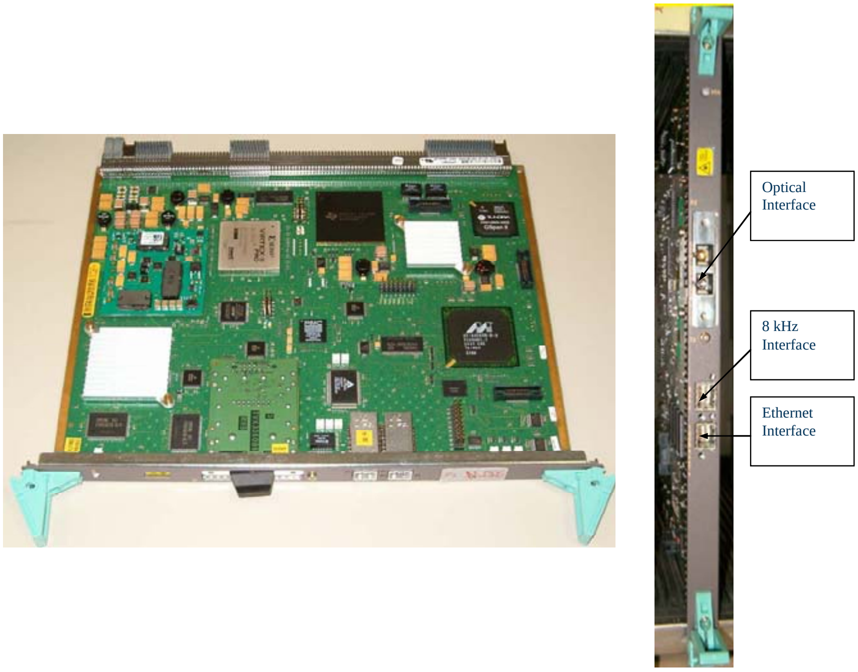


Figure 6-33: ALI-E Plug-In-Unit

MAIN FEATURES

- Termination of STM-1/VC-4 or STS-3c/SPE (optical interface).
- Termination of ATM/AAL2, maximum 2048 AAL2 channels.

  The traffic types carried over AAL2 can be:

  5. Speech, AMR Coded
  6. Speech, PCM 64 kbit/s Coded
  7. Audio (voiceband data, 28.8, 33.6 kbit/s)
  8. Not bit transparent Circuit Switched Data (Unrestricted Digital Information, 14.4, 28.8, 57.6 kbit/s)
  9. Bit Transparent Circuit Switched Data (support of multimedia, 64 kbit/s)

  Different traffic types can be freely distributed within the maximum capacity limit of 2048 AAL2 channels.

  CBR service category.

  Up to 16 VCC for AAL2 channels.

- Termination of ATM/ AAL5/SAAL.

The maximum total bandwidth for SAAL signaling at ATM interface is 9Mbit/s for each direction when used as signaling terminal only. The maximum total bandwidth is 6Mbit/s when used both as exchange terminal and as signaling terminal. Limitations in case of use of RPB-S instead of RPB-E for RP-CP communication shall be taken into account.

nrt-VBR service category.

Up to 64 VCC for AAL5 channels.

INTERFACE OF ALI-E

ALI-E has one STM-1/OC-3 interface for connection to an external network.

It is connected to the group switch of AXE by means of the proprietary DL34 interface, when used as GS-connected. ALI-E can be used together with BYB 501 AXE group switches, GS10/GS12 and GS890. In case connection to GS10/12 GS is required, NNRP5 for DL3/DL34 adaptation is required.

ALI-E is connected to the central processor either with duplicated Serial RP interface or via duplicated Ethernet based RP bus interface.

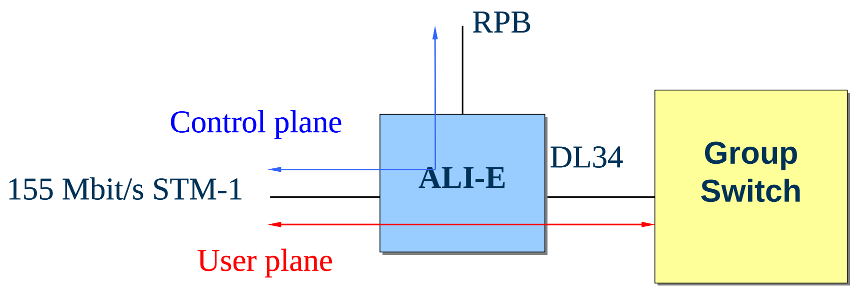


Figure 6-34: Interface of ALI-E

SOFTWARE ARCHITECTURE

The software for ALI-E is structured with functional blocks as shown in Figure 6-10.

The blocks can be divided in categories as follows:

- Command blocks handling the interface towards the operator.
- Application blocks such as SDIPST2, ATMH2, AAL2H2 and SAALH for administration and maintenance.
- A hardware owning block, ETATM2.

- A devices owner block, ETADEV2.
- A hardware driver block, ATMHWD2.
- Interface block such as AAH towards Bearer Control (not belonging to ALI-E CRT).

ALI-E HANDLING OBJECTS

The Handling Objects of ALI-E are as shown in the following picture:

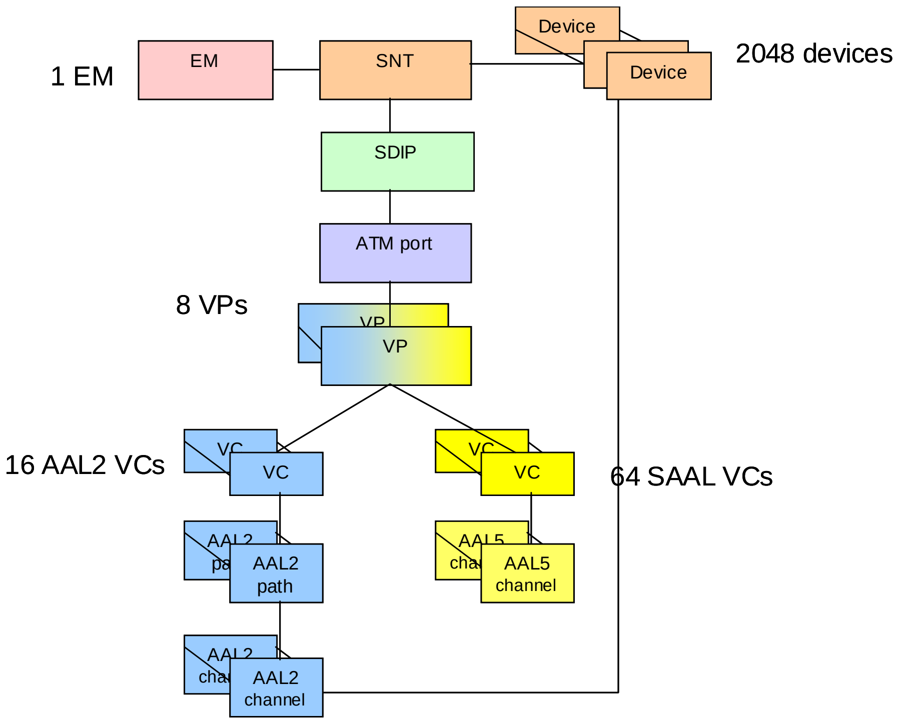


Figure 6-35. ALI-E Handling Objects.

The Switching Network Terminal (SNT) represents the ALI-E equipment.

The Extension Modules (EM) are administered by APZ and mainly used for addressing of the HW.

Each STM-1/OC-3 interface is addressed using the Synchronous Digital Path, SDIP-, object. One SDIP corresponds to one STM-1/OC-3 interface and is given a unique name in the AXE network element. The different layers of the SDH termination (MS, VC-4/SPE) are all addressed using the SDIP name by using an index.

The ATM port addresses the ATM layer and is the entity seen by the upper layers in ALI (AAL layers) and outside ALI-E. There is one ATM port for each ALI-E unit.

Up to 8 Virtual Paths (VP) can be defined for each ATM port. Up to 80 Virtual Channels (VC) can be connected to the VP. A maximum of 16 VCs can be defined for AAL2. A maximum of 64 VCs can be defined for AAL5.

ALI-E CONFIGURATION TYPES

ALI-E can be configured either as GS-connected or as GS-less if used as signaling terminal only. ALI-E GS-less does not require a connection to the GS. Note that ALI-E GS-less and GS-connected cannot coexist on same node, i.e. all ALIs shall be configured either GS-less or GS-connected.

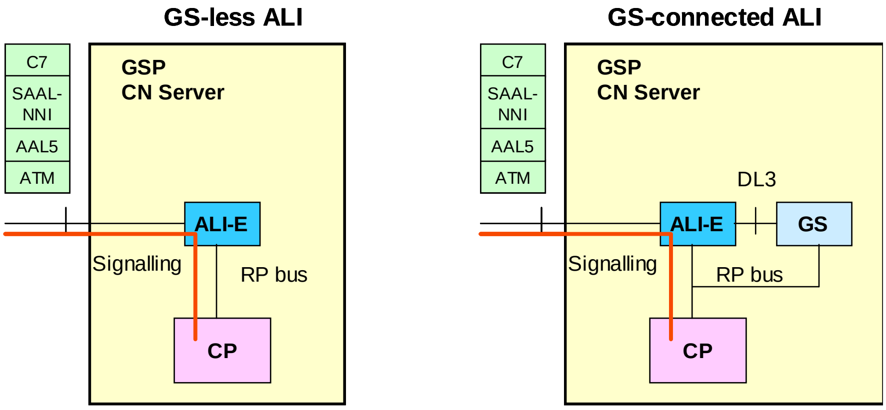


Figure 6-36. ALI-E Configuration Types.

The signaling information is transferred to the central processor via the RP bus where the upper layers of the CCS7 protocol (MTP3 and higher) are processed.

A total number of 64 AAL5 channels are supported. Each AAL5 channel is transported on a Permanent Virtual Circuit (PVC). The ALI can handle up to 8 Virtual Paths.

The AXE parameter ALIST indicates if the ATM Link Interface configuration is GS-connected or GS-less. By default the GS is connected.

Intentionally Blank

7 Location Updating

Objectives

Explore MSC-S BC and HLR communication during Location update process.

- Write the MML for the SCCP and SUA communication between MSC-S BC to HLR by interpreting the exchange requirements.
- Define the MML for roaming agreements by interpreting the exchange requirements.

Figure 7-1. Objectives

Intentionally Blank

INTRODUCTION

In this chapter we will consider the Data Transcript enabling communication between VLR and HLR (and vice versa).

VLR communicates with HLR, when MS/UE initially connects to the MSC/VLR Service Area; this is called a Location Update. VLR may also need to communicate with HLR for other reasons, for example requesting new authentication vectors (triples or quintets) or changing supplementary service information.

HLR communicates with VLR as a response to a request from VLR or if VLR needs to be updated. VLR may need to be updated if there are operator changes, in the HLR, to the MSs/UEs supplementary services.

To support Location Updating a small amount of Data Transcript is required, namely:

- IMSI Number Series Analysis
- SCCP Global Title Analysis
- Global Title Routing Case Analysis

All other SCCP communication requires only:

- SCCP Global Title Analysis.
- Global Title Routing Case Analysis.

LOCATION UPDATING

Figure 7-2 shows how a Location Update takes place.

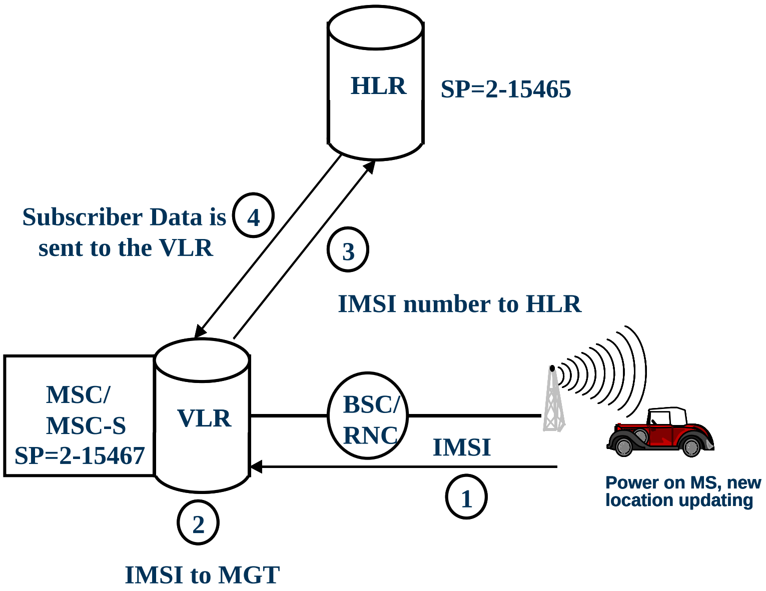


Figure 7-2: Location Updating

The following sequence of events occurs.

1. MS/UE is powered on and it realizes that it is currently located in a new location area. The MS/UE then sends a Location Update Request message up to MSC-S Blade Cluster/VLR. The message contains the IMSI of the MS/UE. The Location Update Request is a message from the DTAP protocol and requires SCCP to carry the message from BSC/RNC to MSC-S BC/VLR. Some SCCP definition is required.

2. In this example the MS/UE has powered on. However, the MSC-S BC/VLR does not recognize the IMSI of the MS/UE and has no information about the subscription. Therefore, MSC–S BC/VLR must request subscriber data from HLR, where the MS/UE subscription is currently located. For this to take place the IMSI must be converted to a Mobile Global Title (MGT) and also determine the MAP version to be used between MSC-S BC/VLR and HLR. All of this information is determined from the IMSI Number Series Analysis.

3. The Update Location MAP message is sent from MSC-S BC /VLR to HLR using SCCP, and, if necessary, MTP is also used. Some SCCP definition is required for this to take place, both in MSC-S BC/VLR, HLR and the other MSC-Servers in the PLMN.

4. The HLR will send back the Insert Subscriber Data (ISD) MAP message. Again SCCP/MTP will be used to transport the MAP message between the HLR and MSC Server/VLR. SCCP data will need to be inserted to allow the MAP message to be terminated in MSC-S BC/VLR.

Note: If there is a Gs interface between MSC Server and SGSN, then the Location Updating and Routing Updating can be combined in one message. However, if there is no Gs interface, the two updating procedures will be independent of one another, thus causing an increase in the amount of signaling taking place.

The translation between SCCP and SUA inside the MSC-S BC will be explained later on.

COMPARISON OF THE OSI REFERENCE MODEL TO THE CCITT NO. 7 MODEL

Comparisons between the CCITT No. 7 and OSI model will be considered.

MESSAGE TRANSFER PART

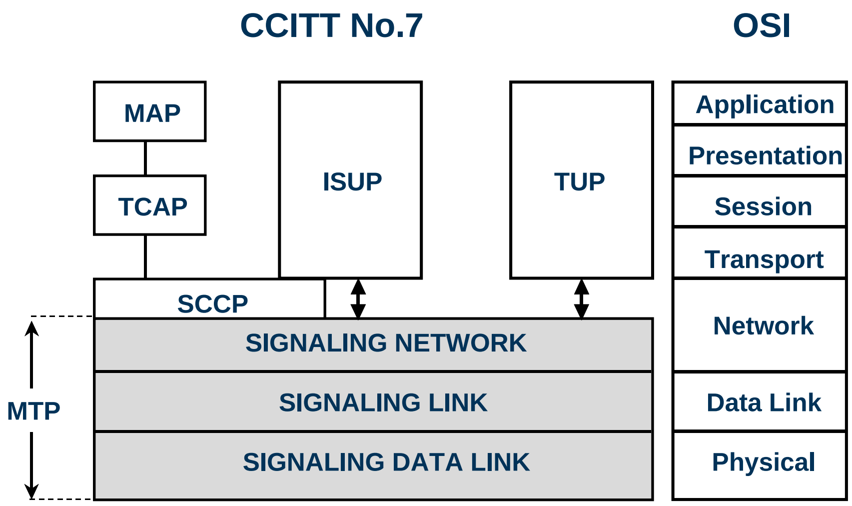


Figure 7-3: SS7 and OSI Model

Figure 7-3 shows that the two models **do not** exactly align with each other, that is, MTP does not fully meet the requirements of the three lower layers of the OSI model.

The first C7 signaling system was developed to carry messages between telephone exchanges for setting up telephone calls in the PSTN. The message is related to the telephone call and is circuit related.

However, the OSI model describes two services at the Network level, **Connection-Orientated service** and a **Connectionless service**. A connection-orientated service allows the exchange of data (set-up, data transfer, and disconnection) between two systems. The connectionless service is a faster way of transmitting small amounts of data. MTP only supports a connectionless service.

SIGNALING CONNECTION CONTROL PART (SCCP)

It can be seen from Figure 7-4, that SCCP is connected above MTP. In the previous section it was stated that the three lower layers of the OSI Model supports a connection-orientated service and a connectionless service. With the addition of SCCP, the requirements of layer 3 (network layer) of the OSI reference model are met.

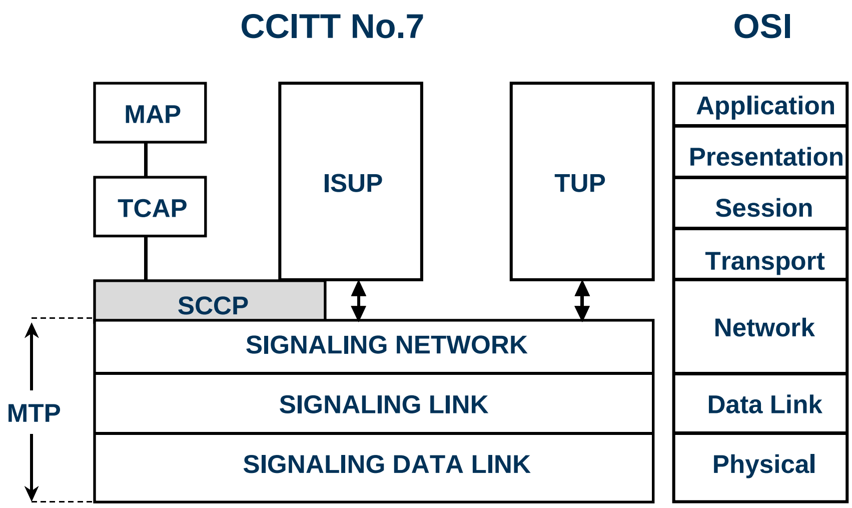


Figure 7-4: Signaling Connection Control Part SCCP

Connectionless Service

The connectionless service transfers a single packet of information at a time between two systems. Each packet will contain some routing information. If the amount of data to be transferred is greater than one packet, the information must be split between several different packets. **Each packet will contain routing information**. The SIF (Signaling Information Field) in the MSU (Message Signaling Unit) has a maximum size of 272 octets. The SIF is made up of the data + the MTP label.

The service is typically used for the transfer of small amounts of real-time critical information, for example, signaling within the mobile network.

Connection Orientated Service

In the connection-orientated service, a logical connection is established between two SCCP nodes by an initial message. The initial message will also contain routing information. The following messages belonging to this connection are given a reference number and a DPC. This means less analysis for each message is required, thus providing a more efficient method of transferring information between two nodes. When the transfer procedure is finished the connection is released.

The Integrated services User Part (ISUP) can use SCCP for end to end signaling.

SCCP Messages

Figure 7-5 gives a breakdown of the SCCP message. The SCCP message is found in the User Information part of the Message Signal Unit (MSU). The rest of the User Information would contain TCAP and MAP information.

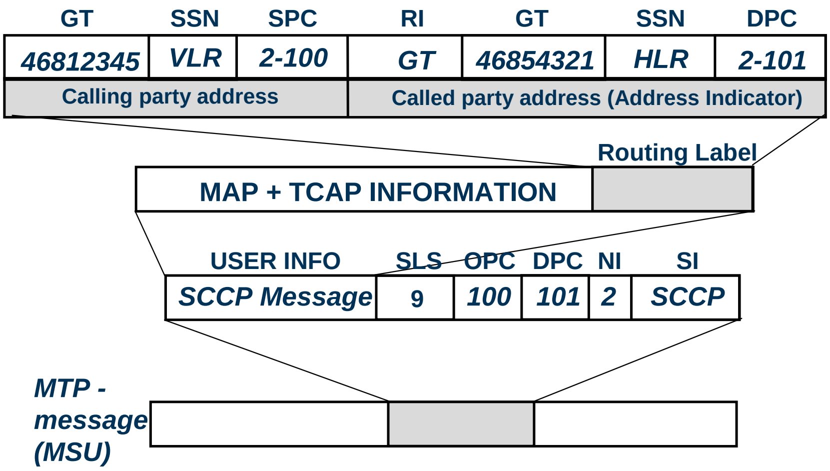


Figure 7-5: Structure of the SCCP Message

The definition of the information contained in the message is given below.

Global Title (GT)

A Global Title (GT) is the address of a node. This unique number is used to signify where the message originated from (referred to as the ‘Calling Party Address’) and also the destination of the message (referred to as the ‘Called Party Address’). The GT has a numbering format based on a dialed number; a number like an MSISDN based on the E.164 series.

The GT is made up of four components, Address Information AI, Nature of Address NA, Numbering Plan NP and the Translation type TT. The allowed values are shown below.
AI is the numerical address of the node and is based on the E.164 series. Both national and international formats are allowed.

NA defines whether the address information is in the national or international format.

NA=3, National

NA=4, International
NP defines the numbering plan of the address information.

NP=1, Number series based on the E.164 numbering plan.

NP=7, Number series based on the E.214 numbering plan.
TT is the Translation Type.

TT=0, is the GSM network.

TT=1-254, is used to communicate with special nodes like the SMS-SC. The value is set by exchange property.

Point Code

DPC is the Destination Point Code and is the destination of the message on the MTP level. SPC is the Signaling Point Code where the message originated.

SubSystem Number (SSN)

The SubSystem Number (SSN) is an address, which identifies the owner or receiver of the message, that is, the user of SCCP. Some examples of the values of SSN are as follows:

- HLR: SSN=6
- VLR: SSN=7
- MSC/GMSC: SSN=8
- EIR: SSN=9
- AUC: SSN=10
- SC: SSN=12
- RNC: SSN=142
- FNR: SSN=253
- BSC (ANSI): SSN=222
- BSC (ETSI): SSN=254

Routing Indicator (RI)

The Routing Indicator (RI) is used to determine how the SCCP message should be routed, either based on the GT and SSN, or DPC and SSN.

This parameter is used for ANSI only.

Routing of SCCP Messages

The routing of SCCP messages uses either the GT and SSN or the DPC and SSN. Below are examples of a network with the commands showing both types of routing.

Routing on the GT

The Data Transcript shown in Figure 7-6 relates to node A.

```
C7RSI:DEST=2-101, LS=2-101, PRIO=1;       !** C7 MTP ROUTING   **!


!***  SCCP ***!

C7NPI:SP=2-101, CON;                      !** COOPERATING SP'S **!

C7NSI:SP=2-101,SSN=7&8;                   !** SSN'S IN NODE    **!

C7GCI:GTRC=1, PSP=2-101, PINTER(,PSSN= ); !** GT ROUTING CASE  **!

C7GSI:TT=0, NP=1, NA=4, NS=491, GTRC=1;   !** GT ANALYSIS      **!
```

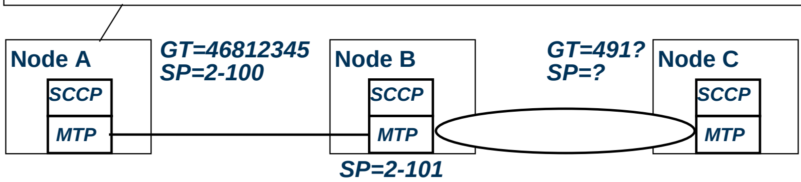


Figure 7-6: Routing of the SCCP Message Using the GT

Node A has an SCCP message that needs to be sent to node C. From the example it can be seen that the GT of node A is 46812345 and that the GT in node C begins with 491…. The two nodes concerned belong to different networks and different countries; 46 is the country code for Sweden, 49 is the country code for Germany.

Since node A does not know the full SPC of node C, node A is unable to give the ultimate destination of the SCCP message.

The SCCP message is routed using the GT from node A to node B. Node B must then analyze the GT and then route the message to the MTP network and then onto node C. In this example node B is classed as an **intermediate SCCP node**.

Data Transcript Definitions

<u>C7RSI</u>

C7RSI is a C7 MTP command specifying the routing of the signaling traffic. Messages with NI=2 and DPC=101 are sent out on Link Set 2-101. (More C7 MTP commands are needed to make a complete MTP definition.)

This command is only used now in the SPX nodes as they are the unique part of the Blade Cluster with TDM interface (optionally). In the MSC or TSC blades this command is not applicable anymore.

C7NPI - cooperating SCCP node

The command C7NPI specifies the cooperating SPs known to the SCCP. That is to say, only cooperating SPs that contain SCCP functionality can be defined using this command. The SP must also have been defined previously in MTP.

The **CON** parameter tells SCCP that the SP status management shall be used for the specified SP. The SCCP management function maintains a list of which SCCP SPs are available. The list is based on SCCP management messages, which are sent between SCCP nodes. If a particular SP is not available, traffic can be stopped, queued, re-routed and so on, depending on the network structure.

This command is only used now in the SPX nodes as they receive the signaling from external nodes. Then, the signaling messages are translate from SCCP to SUA protocol internally.

C7NSI - SSN available at SCCP node

C7NSI defines known subsystems existing in the cooperating SP’s node. The management function also keeps a list of the availability of known subsystems for each SP. All the SSNs of the cooperating SP nodes defined with C7GCI must also be defined with C7NSI.

This command is only used in the SPX nodes in case SUA Associated signaling mode is used. Otherwise is not needed.

C7GCI - Global Title Routing Case

C7GCI defines the Global Title Routing Case (GTRC) and the Primary Signaling Point (PSP). The PSP is the first choice SP to which the signaling traffic is to be directed (see C7RSI). PINTER states that the GT of the signaling traffic routed to this GTRC shall be analyzed further in the PSP (next SCCP node), that is, routing on GT and SSN.

In node B the signaling messages will be received in SCCP from MTP, the GT will be analyzed further and the analysis will lead to further routing.

As global title is analyzed only by MSC blades, neither SPX nodes nor TSC blades need to define it.

C7GSI - Global Title Analysis

C7GSI is the analysis of the GT. It has an operating and non-operating side. Changes are made to the non-operating side and, then, the sides are switched. The main commands to use are C7TZI, C7TCI, C7GSI, C7TAI, C7TAR, and C7GSP.
The GT consists of the address (**NS**), the numbering plan (**NP**) and the number format called nature of address (**NA**). **TT** stands for Translation Type, and can be compared to an origin for analysis. TT is sent in the SCCP signaling message.

- **NP**=1 means MSISDN numbering plan (used in PLMN and ISDN).
- **NA**=4 means international number format.

The GT analysis result is a GTRC.

In Figure below the NS states only the three most significant digits of the Global Title. This is all that node A needs to analyze in order to decide how to route the signaling message. Nodes close to node C will analyze more digits of the GT if required.

Finally the signaling will reach node C where the analysis is terminated on the complete GT. This is not shown in figure but will be discussed later.

Routing on GT will usually be chosen if the next SCCP node is not the terminating node. This will be true for most cases.

Routing on the DPC + SSN

There are now two examples of routing the SCCP message using the DPC and SSN. Example 1 shows only two nodes, while example 2 shows a third node not containing the SCCP functionality.

SCCP messages can be routed on MTP-level through nodes that do not contain SCCP functionality or through nodes where the SCCP functionality should not be used for the particular traffic case.

Example 1

```
C7RSI:DEST=2-101, LS=2-101, PRIO=1;      !** C7 MTP ROUTING   **!


!***  SCCP ***!

C7NPI:SP=2-101, CON;                     !** COOPERATING SP'S **!

C7NSI:SP=2-101,SSN=7&8;                  !** SSN'S IN NODE    **!

C7GCI:GTRC=1, PSP=2-101, PTERM;          !** GT ROUTING CASE  **!

C7GSI:TT=0, NP=1, NA=4, NS=46854321, GTRC=1; !** GT ANALYSIS **!
```

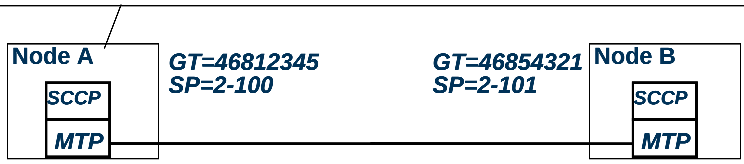


Figure 7-7: Example 1 Routing the SCCP Message on the DPC + SSN

Data Transcript Definitions

C7GCI

In the C7GCI command, the PTERM parameter states that the signaling traffic routed to this GTRC shall be terminated in the PSP (next SCCP node), that is, routing on DPC + SSN.

Note: No GT analysis is required in node B. The message is terminated and distributed to the SSN.

C7GSI

The GT analysis result is a GTRC.

Example 2

```
C7RSI:DEST=2-101, LS=2-200, PRIO=1;      !** C7 MTP ROUTING   **!


!***  SCCP ***!

C7NPI:SP=2-101, CON;                     !** COOPERATING SP'S **!

C7NSI:SP=2-101,SSN=7&8;                  !** SSN'S IN NODE    **!

C7GCI:GTRC=1, PSP=2-101, PTERM;          !** GT ROUTING CASE  **!

C7GSI:TT=0, NP=1, NA=4, NS=46854321, GTRC=1; !** GT ANALYSIS **!
```

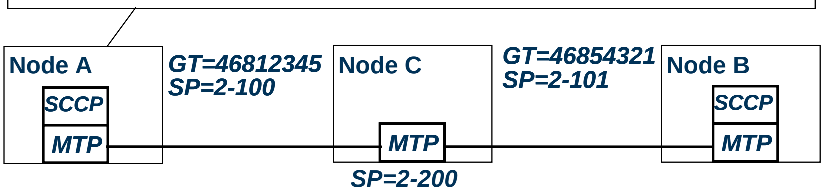


Figure 7-8: Example 2 Routing of SCCP Message on DPC + SSN

Data Transcript Definitions:

<u>C7RSI</u>

Messages with NI=2 and DPC=101 are sent out on Link Set 2-200. In node C the MTP message will be routed further to node B on the MTP level.

<u>C7GCI</u>

In the C7GCI command, the PTERM parameter is used, since the next SCCP node is the terminating node. PINTER would have been used if node B had routed the message further.

Note: Routing on the MTP level can be chosen even when routing via SCCP nodes. The advantage is that the load will be lower in the intermediate node since less analysis will be required. The disadvantage is that the SCCP management functions are not used. The SCCP has more advanced functions for handling congestion and so on, which is useful in complex networks with many routing alternatives.

Terminating SCCP Messages

```
!***  SCCP ***!

C7GCI:GTRC=1, PSP=OWNSP;                    ! GTRC ANALYSIS !

C7GSI:TT=0, NP=1, NA=4, NS=46812345, GTRC=1; !* GT ANALYSIS *!
```

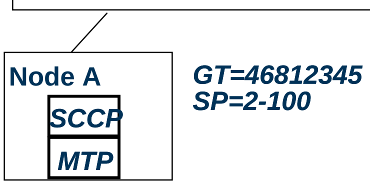


Figure 7-9: Termination of the SCCP Message ITU-T

Termination of SCCP messages in the own exchange is performed using the OWNSP parameter. This terminates the signaling traffic between subsystems in the own node. This line of data is also used to terminate signaling traffic received from other nodes with RI set to routing on GT.

Transaction Capabilities Application Part (TCAP)

The Transaction Capability Application Part (TCAP) is the interface for the Mobile Application Part and other Application Parts to access SCCP.

The Transaction Capabilities Application Part:

- Is a general protocol which makes it easy to introduce new features in the telecommunication network, reducing the need for development of new protocols whenever new features are introduced.
- Defines an end-to-end protocol between TC-users.
- Performs common functions like sending/receiving, coding/decoding and packing/unpacking of information to/from MAP.
- Distributes messages between function blocks.
- Gives each transaction a unique identity, which implies that each TC-user may have several dialogs running at the same time and that there may be several TC-users at the same node.
- Provides only services based on connectionless network services.
- Is used by MAP.
- Is coded according to the Abstract Syntax Notation.1 (ASN.1).

TCAP makes use of the dynamic buffers offered by the APZ function block LAD. The 256w16 buffers are used and have a SAE=348. Two commands are used towards TCAP, C7BPC and C7BPP.

MOBILE APPLICATION PART (MAP)

The Mobile Application Part (MAP)

- Provides the necessary signaling procedures required for transferring of information between GSM and WCDMA networking entities.
- Is situated above TCAP, and together they form layer 7 (Application) of the OSI model.
- Handles the necessary signaling for MSC, MSC-S, GMSC, VLR, FNR, HLR, AUC, SMS-GMSC, and SMS-IWMSC.
- Have functions like, for example: Update Location, Roaming Number Provision, Insert/Delete Subscriber Data, and Prepare Handover.

- Exists in three versions, MAP version 1, MAP version 2 and MAP Version 3. Some MAP versions comprise extended signaling capacity, which is a requirement for some functions.
- Uses connectionless signaling provided by TCAP.

BASE STATION SYSTEM APPLICATION PART (BSSAP)

The BSSAP is used for communication over the A-interface (MSC-BSC) via SCCP and makes use of both the connectionless and connection-orientated services offered by SCCP.

BSSAP has two sets of signaling protocols. One handles the signaling for the BSS management (BSSMAP) and the other handles the Direct Transfer Application Part (DTAP) signaling between the MS and the MSC.

RADIO ACCESS NETWORK APPLICATION PART (RANAP)

A WCDMA systems protocol that provides necessary signaling functions for the communication between the Mobile Services Switching Center (MSC) and the Radio Network Controller (RNC). RANAP also transfers NAS messages. RANAP is for the control information between MSC and RNC whilst NAS is for access signaling between MSC and UE.

IMSI NUMBER SERIES ANALYSIS

When the MS powers on in an MSC-S BC/VLR service area, the MS must carry out a Location Update. If the IMSI is not recognized in the VLR, the VLR must request subscriber information from the HLR where the MS subscription is held. Remember, when a new subscription is taken out, the subscription belongs to one HLR and the MS becomes a visitor whenever it is powered on in the MSC/VLR service area.

The VLR must communicate with the HLR using the MAP signal, Update Location. Any MAP signaling uses SCCP and the SCCP nodes are addressed using a Global Title. A GT is the same format as a dialed number, as it is based on the E.164 series.

The MS has only sent the IMSI (up to the MSC/VLR) which is based on the E.212 series. This is not a dialed number in the telephony network. For the VLR to communicate with the HLR, the IMSI must be modified to a format allowing it to be used in the SCCP network. This new number series is referred to as a Mobile Global Title (MGT) and is based on the E.214 series, made up of the **CC + NDC + MSIN**. The CC identifies the country code, NDC identifies the network and MSIN identifies the subscriber.

Note*: The MGT is only used for Location Updating.*

This MGT is then used to route the MAP signal through the SCCP network from a VLR to the subscriber's HLR.

In case of MSC-S Blade Cluster, the SCCP signaling passes through SPX nodes and then reach the MSC Blades where the GT or SSN is finally analyzed.

Whenever a new roaming agreement is taken out, the information on how to convert the IMSI to a MGT must be specified in each MSC/VLR; this needs to be specified even for the PLMN's own subscribers. This translation is referred to as the IMSI Number Series Analysis.

The IMSI Number Series Analysis also gives information on what the MS is allowed to do within the current PLMN. This can differ from one roaming agreement to another.

Figure below shows the command MGISI and some of the parameters required for specifying a new agreement. The **M** parameter is the modification from the IMSI to the MGT. The **ANRES** parameter specifies what an MS with an IMSIS=234 15 is allowed to do in the network. The available options within ANRES can be found in the AI for Mobile Telephony Data Changeable Exchange Adaptation and further information may be found in AI for blocks MTBSS and MTACC.

```
MGISI:IMSIS= 234 15,
          M= 5-44 385, ! MODIFICATION+MSIN => NS (C7GSI) !
          NA=4,        ! INTERNATIONAL NUMBERPLAN       !
          ANRES=
          OBA-30&      ! BO FOR ORIGINATINGCALLS        !
          BO-32&       ! ORIGION FOR FORWARDEDCALLS     !
          CBA-44&      ! CALL BARRING FOR U.K SUBS.      !
          PLMN-1&      ! ANNOUNCEMENT LANG.INDICATION   !
          ERIS-12&     ! ERICSSON SPECIFIEDSERVICES     !
                        ! B0=1 => SPN, B1=1 => IÇI       !

          MAPVER-0&    ! MAP VERSION                    !
          INOPER-2&     ! IN OPERATOR GROUP              !

          CBAZ-40&     !INTERZONE BARRING               !
          STALL;       !SUBSCRIBER TYPE ALLOWED         !
```

Figure 7-10. IMSI Number Series Analysis

With regard to Location Updating, two of the ANRES parameters are of interest. They are:

- ERIS
- MAPVER

Both relate to the MAP signaling requirements between the VLR and the HLR. ERIS details the services that can be supported between the VLR and HLR, whilst MAPVER specifies the MAP Version. The value ranges and the meaning of these values are given the AI for the owning block of the parameter. For example, MAPVER is owned by MMAPVS.

The IMSI Number Series Analysis Table is made up of an operating and a non-operating side; changes are made to the non-operating side and then switched. The main commands to use are MGIZI, MGICI, MGISI, MGIAI, MGIAR, and MGISP.

When the Update Location MAP signal is sent, the NP parameter in SCCP is set to a default value, NP=7. The GT Analysis must reflect this, as shown in Figure below.

```
C7NPI:SP=2-2, CON;
C7GCI:GTRC=1, PSP=2-2, PINTER;
C7GSI:TT=0, NP=7, NA=4, NS=44, GTRC=1;   !MGT UK Subs!
C7GSI:TT=0, NP=1, NA=4, NS=44, GTRC=1;   !HLR/VLR UK Subs!
```

Figure 7-11: SCCP Data for Location Update

It is very important to remember that if the GT Analysis data for NP=7 does not exist, a location update will not be made.

The second C7GSI command is used to communicate to the HLR on other occasions than at Location Updating, for example requesting triplets.

In practice, these two lines, one with NP=7 (Location Updating) and NP=1 (for all other VLR to HLR communication), would be required for every roaming agreement that exists.

If a PLMN has more than one HLR, the number series would need to be expanded further so as to uniquely identify the individual HLR concerned.

DATA TRANSCRIPT

The following sections contain examples of the Data Transcript for the IMSI Number Series Analysis and SCCP to support the Location Update traffic case.

DATA TRANSCRIPT FOR IMSI NUMBER SERIES ANALYSIS

In the network diagram below is used as a reference for MSC-S BC. It will show the IMSI Number Series Analysis Data Transcript for the IMSIs belonging to the Home PLMN.

Note: If roaming agreements are to be supported, additional lines of MGISI commands are needed.

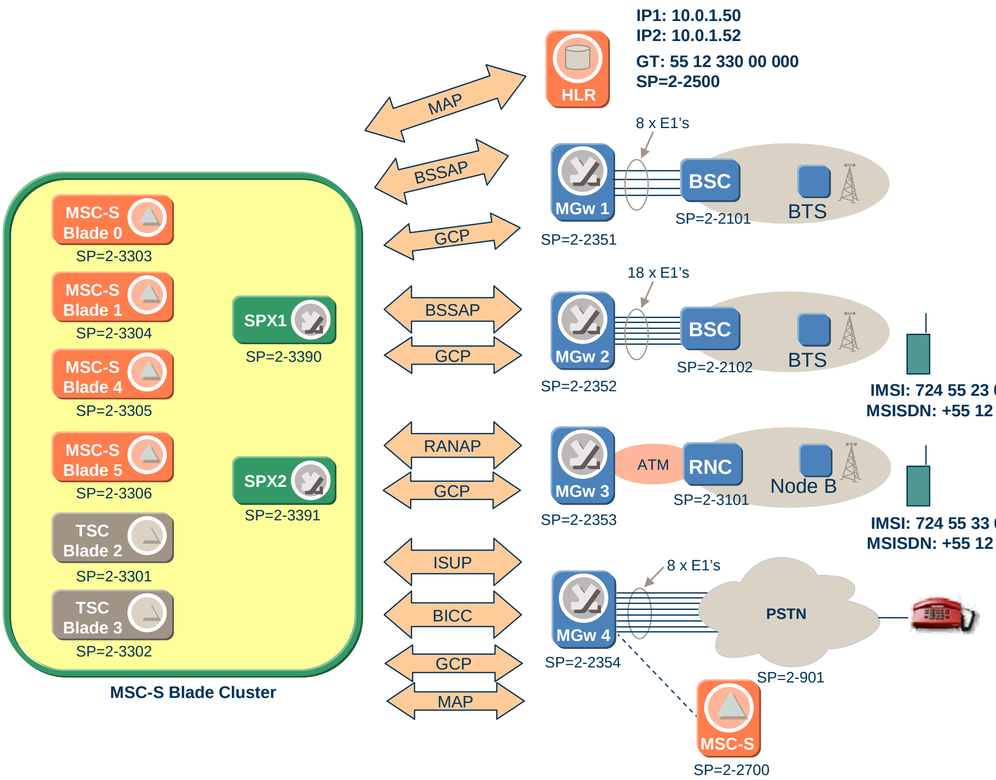


Figure 7-12: Network Diagram

The DT presented here is divided per blade.

```
MGISI:  IMSIS=724 55,
        M=5-55 12 33,  !MODIFICATION + MSIN => NS (C7GSI)!
        NA=4,          !INTERNATIONAL NUMBER PLAN    !
        ANRES=

        OBA-30&        !BO FOR ORIGINATING CALLS     !
        CBA-63&        !CALL BARRING FOR LEBANON SUBS.!
        BO-22&         !BO FOR CALL FORWARD !
        PLMN-0&        !ANNOUNCEMENT LANG. INDICATION!
        ERIS-15&       !ERICSSON SPECIFIED SERVICES  !
                       !B0=1 => SPN, B1=1 => ICI,    !
                       !B2=1 => OIN, B3=1 => DMSISDN !
        MAPVER-2&      !MAP VERSION 3 !
        NRRG-0&        !ROAMING RESTRICTION GROUP    !
        OWNMS&         !OWN PLMN!
        NATMS&         !NATIONAL PLMN !
        CBAZ-40&       !CALL BARRING INTER-ZONAL CALLS!
        STALL;         !SUBSCRIBER TYPE ALLOWED!
```

Figure 7-13: IMSI Series Analysis DT All MSC Blades

In Figure 7-13 all IMSI numbers starting with the digits 724 55 are being converted to a MGT of 55 12 33. This is achieved by removing the first five digits and replacing them with the digits 55 12 33 using the parameter M (M=5-55 12 33). The MGT is in the international format.

To support communication between the VLR and the HLR the ANRES parameters ‘ERIS’ and ‘MAPVER’ are important.

- ERIS is used to identify whether the HLR supports the Ericsson Proprietary Services: Single Personal Number, Immediate Call Itemization, Originating Intelligent Network and Dual MSISDN.
- MAPVER indicates that MAP version 3 is to be used to the HLR.

Some of the other parameters are mandatory parameters but are not relevant for Location Updating. However, they will be explained in a later module.

More information can be found also in the AI for Mobile Telephony Data Changeable Exchange Adaptation and further information may be found in AI for blocks MTBSS and MTACC.

DATA TRANSCRIPT

MTP SCCP and SUA definition

- HLR C7 Signaling Point:
  C7SPI:SP=2-2500 ,OWNSP=ownsp;
  C7PNC:SP=2-2500 ,SPID=HLR1;

  (IHADI… IHASC… M3ASC… M3RSI… M3RAI…towards HLR)

- SCCP Initiate:
  C7NPI:SP=2-2500;
  C7NPC:SP=2-2500 ,MSG=1,MTC=1, HPCCON;

Figure 7-14: MTP & SCCP Definition In the SPXes

As SPX nodes are the one visible to the external nodes, the destination point and the SCCP cooperation of HLR are defined there.

Notice that the HLR SP needs to be changed using the command C7NPC with parameter option HPCCON. That means that this SP point is used in the SCCP level and also in the SUA level.

The parameters MSG and MTC are used to define the SCCP message type (such as UDT, UDTS, Extended Unitdata (XUDT) and Extended Unitdata Service (XUDTS) messages) and MTC (Message type change allowed from XUDT or XUDTS to UDT or UDTS, and the opposite is also true, or from LUDT or LUDTS to XUDT or XUDTS).

Here is not showing the complete DT for SIGTRAN, as this is detailed in the Signaling in MSC-S BC chapter. So, besides all these commands it is also necessary to define all the signaling transport.

User Guide for Message Transfer Part 3 User Adaptation Layer (M3UA) is a good reference as well.

- SUA Signaling definition:

  UAASI:ASID="SMA1000", SPTYPE=SGP, DPC=1000, NI=2, PROT=SUA, RC=1000;
  UAPRI:SPID="3303", PROT=SUA, ASID=" SMA1000 ";
  UAPRI:SPID="3304", PROT=SUA, ASID=" SMA1000 ";
  UAPRI:SPID="3305", PROT=SUA, ASID=" SMA1000 ";
  UAPRI:SPID="3306", PROT=SUA, ASID=" SMA1000 ";

- Hosted Point Code (represents MSC-S):
  C7HPI:HPC=2-1000; !MAP!

Figure 7-15: SUA Definition In the SPXes

Not all the SUA Signaling is shown here such as the Signaling Process (UASPI…) which is defined in the Signaling chapter. Please refer to the signaling chapter for more details.

SUA signaling definition in SPX nodes is using Quasi-Associated Mode as a recommended configuration.

The Adaptation Direction SIGDA: Traffic Data: SUA Network Configuration presents both configurations mode.

In the SPXes should be defined the Application Server process type SGP, that means the process responsible to receive the Hosted Signaling Point from the external network. The RC parameter is mandatory for SGP type.

Also, the ASP processes are used in order to address the blades in the SUA network level. This MSC Blades ASP processes are defined in the implementation phase.

The command C7HPI is used to define the HPC. This HPC is the signaling point used by external nodes to deliver the signaling information to MAP in the MSC-S BC. This command is valid only in SPXs.

- SUA Signaling:

  Definition of ASP for MAP:

  UAASI:ASID="MA1000", SPTYPE=ASP, DPC=1000 NI=2, PROT=SUA;

  Definition of SGP (represents the SPX nodes):

  UASPI:SPID="SPX1", SPTYPE=SGP, PROT=SUA, SAID=ISUSPX1, SGID=SPX1;
  UASPI:SPID="SPX2", SPTYPE=SGP, PROT=SUA, SAID=ISUSPX2, SGID=SPX2;

  Relation between ASP and SGP:

  UAPRI:SPID="SPX1", PROT=SUA, ASID="MA1000",RC=1000;
  UAPRI:SPID="SPX2", PROT=SUA, ASID="MA1000",RC=1000;
  UAPSC:PROT=SUA, STATE=ACT, SPID=SPX1;
  UAPSC:PROT=SUA, STATE=ACT, SPID=SPX2;

Figure 7-16: SUA Definition All MSC Blades

SUA definition in the MSC Blades will be exactly the same data transcript file. All the MSC Blades should have the ASP and SGP processes definition as described above.

For each application protocol such as MAP, BSSAP, RANAP and other needs a correspondent ASP. In the example, the MAP protocol is defined as “MA1000”. The NI (Network Indicator) and DPC (Destination Point Code) are the signaling point seen by the external nodes. In this case the HLR sees the MSC-S BC as SP=2-1000 for MAP signaling messages.

Then, the UAPRI command is used to relate the ASP (application protocol) to SGP. The RC=1000 (Routing Context) represents in the SGP process the specific ASP.

Check the explanation regarding RC in the SUA RFC: “An Application Server Process may be configured to process traffic within more than one Application Server. In this case, the Routing Context parameter is exchanged between the SGP and the ASP (or between two ASPs), identifying the relevant Application Server. From the perspective of an SGP/ASP, the Routing Context uniquely identifies the range of traffic associated with a particular Application Server, which the ASP is configured to receive. There is a 1:1 relationship between a Routing Context value and a Routing Key within an AS. Therefore the Routing Context can be viewed as an index into an AS Table containing the AS Routing Keys”.

Activate the local node behavior process with the correspondent signaling process by using the UAPSC command.

Definition of SP in SUA network:
UANPI:SP=2-2500, ASSP=2-1000;
UANPC:SP=2-2500, SPIDNT=HLR2500;
UANSI:SP=2-2500, SSN=6&10;

Figure 7-17: SUA Definition All MSC Blades (cont.)

This last part from SUA definition is done regarding destination signaling data. Note that the command UANPI is used to define the SP from the HLR, as this network the MSC-S BC is connected directly to the final node. Also, it is associating the local application server process to the SP.

The command UANSI is setting up the SSN (SCCP Subsystem Numbers) which have the same values in the SCCP commands (C7NSI).

Global Title Table definition

- GT Table definition:
  C7TZI;
  C7TCI;
  C7GCI: GTRC=1, PSP=2-2500, PTERM; !HLR1!
  C7GCI: GTRC=2, PSP=OWNSP;
  C7GSI:TT=0, NA=4, NP=1, NS=551233, GTRC=1;
  C7GSI:TT=0, NA=3, NP=1, NS=1233, GTRC=1;
  C7GSI:TT=0, NA=4, NP=7, NS=551233, GTRC=1; !MGT – HLR1!
  C7GSI:TT=0, NA=4, NP=1, NS=551211, GTRC=2;
  C7GSI:TT=0, NA=3, NP=1, NS=1211, GTRC=2;
  C7TAI;
  C7TAR;
  C7TLI;

Figure 7-18: Global Title Analysis table All MSC Blades

The GT analysis in done only in the MSC blades, neither TSC blades nor SPX nodes do that.

C7TZI command is used to zeroing the non-operating table and the C7TCI is used to copying all the data in the operating side to the non-operating side. This procedure guarantee that all the time the table is modified the previous content is there.

The parameters have been described in the section before.

- Definition of Own Calling Address:

MGCAC:INT=55 12 1123 40000, NAT=12 1123 40000;
!Own address for MSC/GMSC!

Figure 7-19: Define the Own Calling Address All MSC Blades

There is no definition of Calling Address in the TSC Blades either SPX nodes.

Intentionally Blank

8 Telecommunication Services Analysis

Objectives

Outline Telecommunication Service Analysis performance in the MSC-S BC according to the system specifications.

- Define the TSA for a teleservice (TS) and for a bearer service (BS).
- Identify the TMR analysis input and output parameters.
- Name the purpose of the Compatibility Check

Figure 8-1. Objectives

Intentionally Blank

INTRODUCTION

The Telecommunication service analysis is mandatory.

It specifies the telecommunication services available in the network, and also the demands on the WCDMA or GSM network to support a specific service. It is divided into two parts: one to identify the service requested, and one to specify the requirements for the connection. It will be performed for both mobile originating and mobile terminating calls.

BEARER CAPABILITIES (BC)

Within an Integrated Services Digital Network (ISDN), a Public Switched Telephony Network (PSTN), and a WCDMA or GSM network, a number of different services are available. These services include speech, facsimile, and data transmission with different user rate (URATEs). The receiving node, as well as intermediate nodes, need information on what service is requested and how the service is to be performed, for example, what URATE is used.

The basis for determining call type is the *Bearer Capability* (BC).

BCs only apply to WCDMA, GSM and ISDN since PSTN cannot provide this information.

Different coding schemes and protocol stacks are used in ISDN and WCDMA/GSM because different transmission requirements must be met. They are referred to as ISDN BC and WCDMA/GSM BC respectively.

The WCDMA or GSM BC and the ISDN BC are different from each other so an incoming ISDN call needs to translate the BC while an incoming PSTN call needs to generate a WCDMA BC in the WCDMA or a GSM BC in a GSM.

Bearer Capabilities (BCs) contain this information. BCs are part of the User Service Information Element (USIE) in the Initial Address Message (IAM), and the Bearer Capability Information Element (BCIE) in the SETUP message.

Note: This only applies to ISDN and GSM/WCDMA, since PSTN cannot provide this type of information.

For an UE originated call, the WCDMA BC is received from the UE.

For an MS originated call, the GSM BC is received from the MS.

For a call coming from PSTN/ISDN there are 3 possibilities:

- The incoming route supports ISUP. The ISDN BC is translated into a WCDMA/GSM BC in the HLR by software.
- Only the MSISDN is received. In this case a default BC is generated for the call. This default BC setting is generated by the subscriber data DBSG (Default Basic Service Group). This would be the case for all calls generated in PSTN where ISUP is not supported.
- The third alternative is for calls with no BC requiring support of DTI/DTI2 or any other services not supported by the DBSG. In this case an additional MSISDN (AMSISDN) is used to identify this particular service.

An exchange in WCDMA or GSM must be able to provide:

- Translation of ISDN BC to WCDMA/GSM BC and vice-versa (HLR).
- Translation of the requested service into requirements on signaling and transmission capabilities.
- Compatibility check to determine if the required signaling and transmission capabilities are fulfilled by the route or equipment to be used.

GSM/WCDMA DATACOM SERVICES

This feature provides the basic functionality needed for circuit-switched data services for speeds of up to 9.6 kbit/s (for GSM) and 64 kbps (for WCDMA). Data compression is also part of this basic feature.

The feature also provides the basis for the optional features Fax, High Speed Datacom Service (for GSM) and Integrated Access System (IAS).

The feature supports connections between WCDMA subscribers and subscribers using modems over PSTN or Unrestricted Digital Information (UDI) over ISDN. It also supports connections using Frame Tunneling Mode (FTM).

The data services provided by this feature can be used for a multitude of applications, some of the most important being WAP, Internet access, or remote access to a corporate LAN.

Data Transmission Interworking Unit (DTI) platforms

In order to support data services within GSM/WCDMA networks, a GSM/WCDMA Interworking Function (IWF) is needed. The Ericsson implementation of this IWF is the DTI (Data Transmission Interworking Unit). The DTI exists in two versions, DTI and DTI2, of which the DTI2 is the standard product for new deliveries.

The MSC Server will utilize the DTI hardware in a remote Media Gateway.

The DTI/DTI2 is a protocol converter for circuit-switched data communication via the MSC which enables mobile data and fax users to connect to either ISDN/PSTN services or to the Internet via an Integrated Access System (IAS).

Both Mobile Originated and Mobile Terminated calls are supported, as well as Mobile-to-Mobile calls. Combining the two first cases does the latter case.

Bearer Services for GSM and WCDMA

All services within the GSM network, be it speech, SMS, data or fax, are assigned a telecommunication service. This service is divided into two categories, Teleservices and Bearer services. Bearer services provide the means to transfer speech and data information between users. Teleservices provide the complete capability, including terminal equipment functions, for communication between users according to operator agreed protocols.

Table 9-1 shows the supported Bearer services in the MSC. Some datacom terms are explained below.

Information Transfer Capability (ITC)

ITC is part of the Bearer Capability (BC). Every call in a GSM/WCDMA network involves the exchange of the BC between the mobile phone and the network in order to inform the network of what services are connected to the call. The ITC capability can be “speech”, “fax”, “UDI” or “3.1 kHz”. Unrestricted Digital Information (UDI) is used for digital calls over the ISDN, and 3.1 kHz is used for modem calls.

Synchronous/Asynchronous Transmission

In synchronous mode, blocks of data are transmitted using “sync characters” to synchronize transmitter and receiver. This gives higher transmission rates, but requires accurate and expensive clock circuits. In asynchronous mode, start and stop bits are used when transmitting characters. This allows for easier synchronization and variable transmission speed, although it is slower than synchronous mode.

Transparent/Non-transparent service

Transparent service (T) transmits data transparently across a radio interface. The transmission speed will be constant, but bit error rates might be high. Nontransparent service (NT) uses a Radio Link Protocol (RLP) between the mobile phone and the DTI/DTI2, thus guaranteeing error-free transmission. The V.42 error correction protocol can be used for all modem types, except V.21.

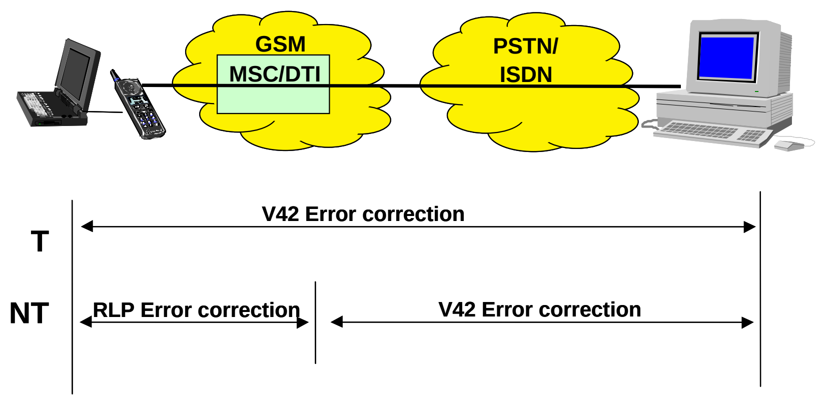


Figure 8-2: Transparent and Non-transparent services in the GSM network

Bearer Service	Radio Access Rate (bps)	Access Structure	Information Transfer Capability	QOS Attribute	Notes
20	300	Async	UDI or 3.1 kHz	T or NT	3)
20	1200	Async	UDI or 3.1 kHz	T or NT	3)
20	2400	Async	UDI or 3.1kHz	T or NT	3)
20	4800	Async	UDI or 3.1kHz	T or NT	3)
20	9600	Async	UDI or 3.1kHz	T or NT	
20	14400	Async	UDI or 3.1kHz	T or NT	1)
20	19200	Async	UDI or 3.1 kHz	T or NT	1)
20	28800	Async	UDI or 3.1kHz	T or NT	1)
20	38400	Async	UDI or 3.1kHz	NT	1) 2)
20	43200	Async	3.1kHz or “FTM”	NT	1) 2) 4)
20	57600	Async	3.1kHz or “FTM”	NT	1) 2) 4)
30	1200	Sync	UDI or 3.1kHz	T	3)
30	2400	Sync	UDI or 3.1kHz	T	3)
30	4800	Sync	UDI or 3.1kHz	T	3)
30	9600	Sync	UDI or 3.1kHz	T	
30	14400	Sync	UDI or 3.1kHz	T	1)
30	19200	Sync	UDI or 3.1kHz	T	1)
30	28800	Sync	UDI or 3.1kHz	T	1)
30	38400	Sync	UDI	T	1)
30	48000	Sync	UDI	T	1)
30	56000	Sync	UDI	T	1)

Table 9-2: Supported User/Access Rates for GSM

1) Requires the optional feature NF 954 High Speed Datacom Service.

2) 3.1 kHz requires V.90 (implemented in DTI2).

3)The old Bearer Services 21-26 and 31-34 have been removed from the 3GPP specifications, and the rates can be reached by negotiation according to the specifications.

4) FTM gives possibilities of 64 kbps connection on the fixed side of the IWF. See session ‘Frame Tunneling Mode’.

All services within the WCDMA network are assigned a Bearer Service that provides the means to transfer speech and data information between users. Table 9-3 shows the supported user rates. On the radio interface, only the rates 14.4, 28.8 and 57.6 kbit/s are supported. The feature supports only Non-Transparent services and there is therefore no straightforward relation between Air Interface User Rate (AIUR) and Fixed Network User Rate (FNUR).

FNUR (bps)	Access Structure	Information Transfer Capability	User Information Layer 1 Protocol	QoS Attribute	Note
9 600	Asynchronous	UDI or 3.1kHz	UDI:V.110	NT	
14 400	Asynchronous	UDI or 3.1kHz	UDI:V.110	NT	
19 200	Asynchronous	UDI or 3.1kHz	UDI:V.110	NT	
28 800	Asynchronous	UDI or 3.1kHz	UDI:V.110	NT	
38 400	Asynchronous	UDI or 3.1kHz	UDI:V.110	NT	(Note 1)
56 000	Asynchronous	RDI	X.31 flag stuffing	NT	(Note 2)
64 000	Asynchronous	UDI	X.31 flag stuffing	NT	(Note 2)
56 000	Synchronous	RDI	Not Applicable	T	(Note 3)
64 000	Synchronous	UDI	Not Applicable	T	(Note 3)

Table 9-3: Supported user rates

Note 1: The FNUR rate only applies to UDI. For 3.1 kHz, to connect with high-speed modems such as V.90, or modem rates below 9.6 kbit/s, autobauding is used. FNUR has no meaning in this case.

Note 2: Frame Tunneling Mode, using HDLC framing on the fixed network interface.

Note 3: 64/56 kbps Synchronous Transparent UDI/RDI service are used for 3G.324M Multimedia calls, and is part of the optional feature NF 956.

Some datacom terms in the table that are part of the Bearer Capability (BC) are explained below. Every call in a WCDMA network involves the exchange of the BC between the mobile phone and the network in order to inform the network of what services are connected to the call.

Fixed Network User rate (FNUR)

The user rate between DTI2 and the fixed network. That is, the rate that applies for the connection between the MSC and the terminal that is connected to PSTN/ISDN or the Access Serves that is connected to Internet.

The FNUR can be compared to the Air Interface User Rate (AIUR), which is the user rate over the air interface. FNUR and AIUR can be different for Non-Transparent services since frequent re-transmission may be required on the radio interface due to varying radio conditions.

Asynchronous Transmission

In asynchronous mode, start and stop bits are used when transmitting characters. This allows for easier synchronization and variable transmission speed, although it is slower than synchronous mode.

Information Transfer Capability (ITC)

The ITC capability can be “speech”, “UDI”, “RDI” or “3.1 kHz”. Unrestricted Digital Information (UDI) is used for digital calls over the ISDN or Internet. Restricted Digital Information (RDI) is used in networks that utilize ANSI/Bellcore ISDN signaling. 3.1 kHz is used for modem calls.

Non-transparent service (NT)

Non-transparent service provides error-correction by using the Radio Link Protocol (RLP) between the mobile phone and the DTI2, thus guaranteeing error-free transmission. For error correction over the fixed network, this can only be done when using 3.1 kHz connection. The V.42 error correction protocol can be used over all supported modem types.

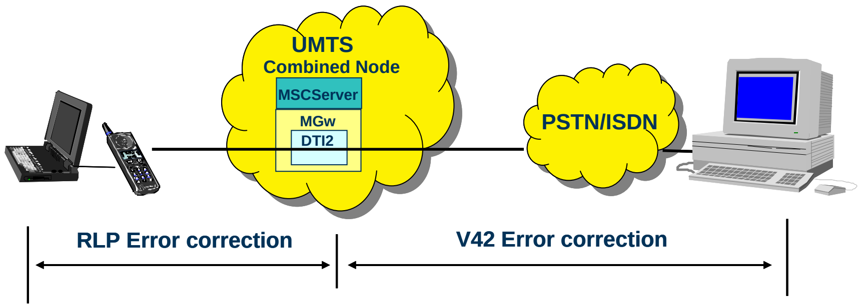


Figure 8-3: Error correction for Non-transparent services in the WCDMA network

Modem services

The Information Transfer Capability (ITC) in the GSM/WCDMA Bearer Capability dictates what type of service will be required for the call. The 3.1 kHz ex PLMN refers to data calls that require a modem connection over the PSTN.

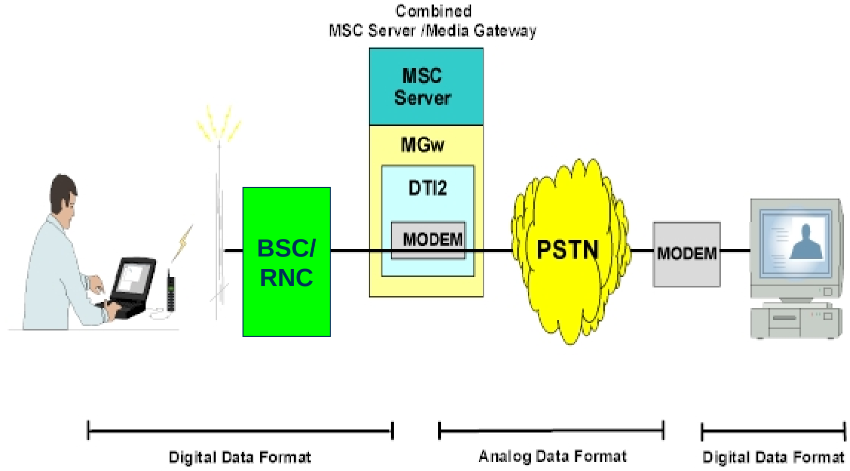


Figure 8-4: 3.1 kHz call via modem over the PSTN for GSM/WCDMA

The DTI/DTI2 provides modem functionality in accordance with the following ITU-T specifications:

V.21	300 bps asynchronous
V.22	1200 bps asynchronous/synchronous
V.22bis	2400 bps asynchronous/synchronous
V.32	9.6 and 4.8 kbps asynchronous/synchronous
V.34	2.4 to 33.6 kbps synchronous

V.90 Up to 56 kbps asynchronous/synchronous

All speeds above 9.6 kbits/s require the optional feature High Speed Datacom, which includes HSCSD and 14.4 channel coding.

For asynchronous bearer services all modems are supported. For synchronous bearer services, V.22, V.22bis and V.32 are supported; additionally V.34 on 9.6 kbps is supported.

Speeds below 9.6 kbps are negotiated via autobauding. Synchronous modems can be used even though the bearer service is asynchronous. For instance can the service be asynchronous between the mobile and the DTI2, but synchronous from DTI2 over the fixed network. Since the feature supports only Non-Transparent services, the rate between air interface and fixed network can differ.

UDI towards ISDN

This function supports connections between GSM / WCDMA subscribers and ISDN subscribers using “Unrestricted Digital Information" (UDI) Information Transfer Capability (digital 64 kbps) or “Restricted Digital Information” (RDI) (56 kbps) in the ISDN. The UDI service covers calls using V.110/X.30 rate adaptation within the ISDN.

A call requesting UDI will terminate at an ISDN connection via a Terminal Adapter. UDI calls can also be made from mobile to mobile because the GSM network is based on ISDN principles. Please note that for mobile to mobile and mobile to ISDN calls it is also possible to use modems as an alternative to UDI.

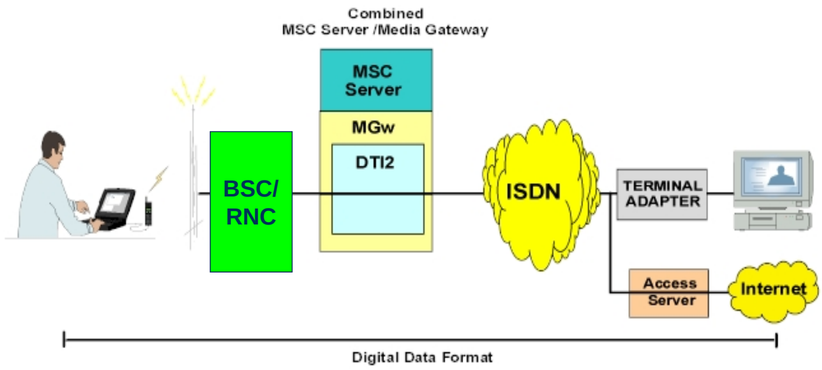


Figure 8-5: UDI call via ISDN for GSM/WCDMA

A call requesting UDI/RDI will terminate at an ISDN connection via a Terminal Adapter.

The UDI/RDI service is also used for connection to Internet. This is illustrated in Figure 8-6 where the UDI call is terminated in an Access Server. The Access Server can be both external (as in Figure 8-6) and integrated with the MSC by using the optional Integrated Access System (IAS).

Data Compression

Data Compression according to the V.42bis standard increases user data rates without changing the characteristics of the radio channel. It is used for asynchronous, non-transparent bearer services. Data compression can also be used together with High Speed Circuit-Switched Data and 14.4 kbit/s Data Channel Coding.

Data compression may be done on the wireless and/or on the wireline side. Furthermore V.42bis is capable of compressing data in either both or only one of the directions. The V.42bis algorithm provides a mechanism to detect if the user data cannot be compressed, upon which it changes to transparent mode. When the algorithm detects that compression is possible again, it reverts back to compressed mode.

Typical compression ratios achievable are:

2:1	data transmission (e.g. HTML)
3:1	text transmission

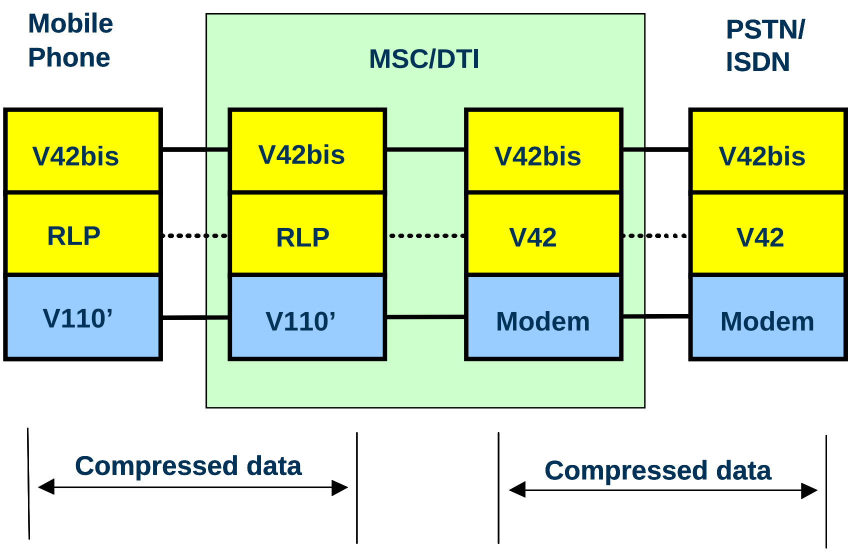


Figure 8-6: Data Compression GSM / WCDMA

Figure 8-7 shows the protocol model for an asynchronous, non-transparent data call, with V.42bis data compression on top of V.42 and RLP error correction layers. V110’ is the modified V110 frame used in GSM/WCDMA. A digital data call (UDI/RDI/FTM) does not use V.42 or V.42bis on the fixed side

Frame Tunneling Mode for GSM

The Frame Tunneling Mode feature provides synchronous data transmission through the DTI/DTI2 without the need for modems or V110 rate-adaptation. This results in a service that provides much faster connection time than modem (connection time for FTM is similar to ISDN), in addition to the added advantage of high connection speed (64 kbps, compared to maximal 38,4 kbps for normal ISDN, and 48 kbps for V.120).

Frame Tunneling Mode supports PPP and X.75 protocol links through the DTI/DTI2. This can be used for Internet connections via the Integrated Access System (IAS) or via an ISDN network. It is possible to use all the data rates supported on the radio interface for Frame Tunneling Mode calls. Frame Tunneling Mode is also called HDLC (High-level Data Link Control) encapsulation on ISDN.

Frame Tunneling Mode for WCDMA

The Frame Tunneling Mode service provides synchronous data transmission through the DTI2 without the need for modems, and it replaces V.110 rate-adaptation with HDLC rate adaptation. Conventional modem or V.110 data calls are asynchronous, with a start and stop bit added to every data byte transferred. Frame Tunneling Mode provides synchronous data transmission through the DTI2, which eliminates the need for start and stop bits. Although this in fact does not improve the throughput over the air, FTM connects at 64 kbit/s on the fixed network, while V.110 connects at 38.4 kbit/s, which affects the data transfer considerably. FTM also allows connection to equipment that does not support V.110.

Frame Tunneling Mode supports PPP and X.75 protocol links through the DTI2. This can be used for Internet connections via the Integrated Access System (IAS) or via an ISDN network. It is possible to use all the data rates supported on the radio interface for Frame Tunneling Mode calls. For WCDMA these are 14.4, 28.8 and 57.6 kbit/s.

Frame Tunneling Mode also supports the proprietary feature ASHDLC (Async-to-sync HDLC, sometimes also referred to as HDLC (High-level Data Link Control) encapsulation on ISDN. The ASHDLC service is initiated by a prefix to the B-number instead of being signaled by the mobile. When the MSC identifies the prefix, it is removed from the called number before the service is invoked.

3G.324M MULTIMEDIA SUPPORT

This feature provides the support for sending and receiving circuit-switched multimedia for both WCDMA systems and GSM. Circuit-switched multimedia is based on the 3G.324M standard, which is a 3G-variant of H.324, an ITU-T recommendation for low bit-rate multimedia communication.

The following multimedia call cases are supported:

- Multimedia calls between WCDMA subscribers
- Multimedia calls between WCDMA and ISDN subscribers
- Multimedia calls between GSM subscribers
- Multimedia calls between GSM subscribers and PSTN subscribers

A mobile subscriber with a 3G.324M terminal can get video, data and audio communication with another 3G.324M terminal or with a terminal that is compatible with 3G.324M. The other terminal could also be a Video Content Server, acting in accordance with the 3G.324M standard.

The 3G.324M recommendation includes the multiplexing of different bit streams into one bit stream

For a multimedia call, the BS30 Bearer Service is used, which provides guaranteed quality of service for multimedia communication. In the case of WCDMA, the bit-transparent service is used in combination with Unrestricted Digital Information (UDI). Bearer Service 30 in the transparent mode is also used for GSM multimedia calls. In this case the capability of the call is set to "3.1 kHz audio" which means that the call is treated as an analog call using modems for transfer over PSTN. The user rate will be 28.8 kbps, using High Speed Circuit Switched Data (HSCSD).

The example in Figure 8-8 illustrates a multimedia call between two W 3G.324 M terminals. The call is using Unrestricted Digital Information (64 kbps) as a bearer. The MSC routes the 3G.324 M call based on the E-164 number provided by the calling terminal at call set-up. The video/audio media negotiation between the terminals is transparent to the MSC. In the picture this negotiation is therefore shown as a "closed pipe" going through the MSC.

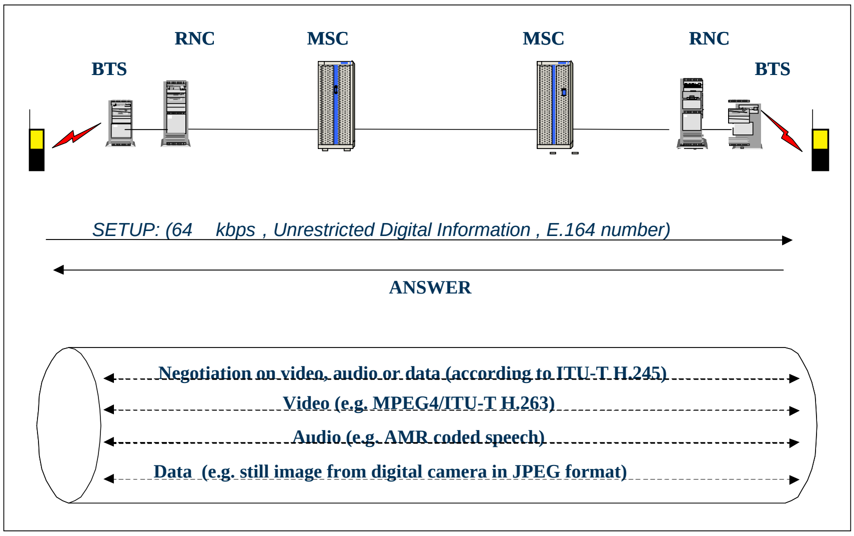


Figure 8-7: WCDMA Multimedia Call

TELECOMMUNICATION SERVICE ANALYSIS

Telecommunication service analysis must be performed at every call set-up.

The telecommunication service analysis DT is only defined in the MSC Blades.

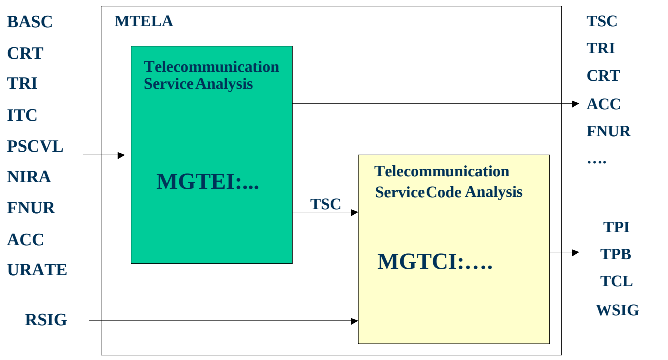
The input to this analysis is the BASC information along with additional parameters.

The incoming parameters are analyzed and the result adapts to and configures the system for the selected service, for example, establishing a DTI/DTI2 connection for a fax or data call.

The analysis is composed of two parts:

1. Telecommunication Service Analysis.

2. Telecommunication Service Code Analysis.



ITC **Information transfer capability 3.1khz-UDI-Speech**
CRT **Channel rate type**

Figure 8-8: Telecommunication Service Analysis Schematic

The input to this analysis is: (See Figure 8-9).

- The Basic Service Code (BASC). It is either a Teleservice Code (TEC) concerning speech, Short Message Service (SMS), facsimile, emergency call, or a Bearer service Group (BEG) concerning data call

- The Information Transfer Capability (ITC) is either AUDIO for 3.1 khz modem connections, or Restricted Digital Information (RDI), or Unrestricted Digital Information (UDI)

- Negotiation of Intermediate Rate Allowance (NIRA) indicates whether the Negotiation of intermediate rate function is allowed or not

- Required type of SIGnaling (RSIG) indicates any special signaling requirements such as ISDN

- Fixed Network User Rate (FNUR) indicates the user rate signaled and transmitted towards the remote user.

- Provided Speech Coder Version List (PSCVL) contains the version list for speech coder selection

- SERVICE indicates different WCDMA data services (Basic data service (BASIC), Bit transparent service (BT), Frame Tunneling Mode (FTM) and Multi Media service (MM)).

- Transparency Indicator (TRI) indicates if a transparent or a non-transparent connection.

Note: No DTISC anymore in Telecom Service Analysis

The output from the first leg of the analysis (MGTEI) is:

- Channel Rate and Type (CRT) is expressed as RCR-SCRT

- TRI (Transparent Indicator). It indicates if transparent or non-transparent mode should be used for Bearer Services (BSs). Only used for fax and data calls

- Allowed Speech Coder Version List (ASCVL). The input parameter PSCVL defined in the analysis is compared and ASCVL is generated. This is only for speech calls.

- Selected Negotiation of Intermediate Rate Request (SNIRR). The NIRA parameter in the input is compared to the PSCVL and SNIRR is generated.

- Fixed Network user rate (FNUR) allows a user rate from 9.6kbit/s to 64kbit/s depending on the commercial agreement.

- TeleService communication Code (TSC)

  This parameter is a numeric output from the Telecommunication Service Analysis. It serves as an:

  – Input to Telecommunication Service Code Analysis

The requested service is supported by the MSC, only if the Telecommunication Service Analysis points out a TSC

- Input to charging.

  It provides the ability to apply different charging methods to different call types, for example, a fax call may be more expensive than a speech call. TSC is used as a reference in the TT-files.

The output from the Telecommunication Service Analysis is the TSC. It is used as a link to the Telecommunication Service Code Analysis defined with command MGTCI, and as a branching parameter in the Charging analysis.

The outputs from the second leg of the analysis (MGTCI) is: (See Figure 8-9).

- Wanted type of SIGnaling (WSIG). The defined WSIG in the analysis is compared to the RSIG of the input signal and a final WSIG is generated
- Tone Protection Information (TPI). Whether tone sending is allowed or not. It is not allowed here for data and fax calls but it is allowed for speech and alternate speech/fax. If the parameter is left out (as in the SMS case), information in the BC will be used to determine eventual tone protection.
- TPI is used to prevent tone sending for certain types of calls.
- Transmission Break Protection (TBP). Protects against breaks in the transmission. Only set for fax and data calls.
- Traffic Class (TCL). A value that is used in case of mobile originating call to PSTN to identify call type. Only specified for fax and data calls.

Commands for Telecommunication Service Analysis Data

MGTEI and MGTCI are used to define the Telecommunication Service Analysis. Examples:

```
MGTCI:TSC=1,WSIG=NOIS,TBP=NO,TPI=YES,NOTE="THY";
```

A TSC for speech is defined with no requirement on signaling capabilities (NOIS) transmission breaks (TBP) are not protected (that is, they are allowed) and tone sending (TPI) is allowed.

```
MGTEI:TEC=THY,CRT=DFR-DFRC,PSCVL=FRV1&FRV3,TSC=1;
```

The radio channel requirement (RCR) defined for TSC=1 is a dual rate channel, full rate preferred. The selected channel rate and type (SCRT) is dual rate, full rate preferred with change allowed after first channel allocation. The provided speech coder version list contains the speech coder full rate version 1 and 3.

```
MGTCI: TSC=21,WSIG=ISPR,TBP=YES,TPI=NO,TCL=12,
       NOTE="DA_ANT";
```

A TSC for asynchronous data transmission is defined with ISDN preferred. Transmission breaks and tone sending are not allowed.

```
MGTEI: BEG=DCDA,URATE="0,3",TRI=NT,CRT=FR-FR&
       DFR-FR, TSC=21,NIRA=1;
```

The Radio Channel Requirement (RCR) defined for TSC=21 is full rate and dual rate, full rate preferred. The corresponding selected channel rate and types (SCRT) are both full rate. Negotiation of intermediate rate is allowed for this service.

DATA TRANSCRIPT TELECOMMUNICATION SERVICE ANALYSIS

In the following figures example definitions are given for a telecommunication service analysis. For a complete explanation of the parameters and the possible values see OPI *Mobile Telephony, Telecommunication Service Analysis Data, Define*.

```
***_TELECOMMUNICATION_SERVICE_CODE_DATA_***;
MGTCI:TSC=11, WSIG=NOIS, TBP= NO, TPI=YES, NOTE="THY    ";
MGTCI:TSC=12, WSIG=NOIS, TBP= NO, TPI=YES, NOTE="AUXTHY ";
MGTCI:TSC=99, WSIG=NOIS, TBP= NO, TPI=YES, NOTE="EMERG  ";

***_TELECOMMUNICATION_SERVICE_ANALYSIS_DATA_***
*** GSM ***
MGTEI:TEC=THY,   TSC=11,CRT=FR-FR,            PSCVL=FRV1&FRV2;
MGTEI:TEC=THY,   TSC=11,CRT=DFR-DFRC,         PSCVL=FRV1&FRV2&HRV1;
MGTEI:TEC=THY,   TSC=11,CRT=DHR-DHRC,         PSCVL=FRV1&FRV2&HRV1;
MGTEI:TEC=AUXTHY,TSC=12,CRT=FR-FR,            PSCVL=FRV1&FRV2;
MGTEI:TEC=EMERG, TSC=99,CRT=FR-FR,            PSCVL=FRV1&FRV2;
MGTEI:TEC=EMERG, TSC=99,CRT=DHR-DHRC&DFR-DFRC,PSCVL=FRV1&HRV1;

*** UMTS ***
MGTEI:TEC=THY,    TSC=11    ,UMTS;
MGTEI:TEC=AUXTHY, TSC=12    ,UMTS;
MGTEI:TEC=EMERG,  TSC=99    ,UMTS;
```

Figure 8-9: Definitions for Speech in GSM and WCDMA systems

```
***_TELECOMMUNICATION_SERVICE_CODE_DATA_***;

MGTCI:TSC=13, WSIG=NOIS, TBP= NO, NOTE="SMSMO";
MGTCI:TSC=14, WSIG=NOIS, TBP= NO, NOTE="SMSMT";

***_TELECOMMUNICATION_SERVICE_ANALYSIS_DATA_***

MGTEI:TEC=SMSMO,    TSC=13;
MGTEI:TEC=SMSMT,    TSC=14;
```

Figure 8-10: Definitions for Short Message Service

```
***_TELECOMMUNICATION_SERVICE_CODE_DATA_***;

MGTCI:TSC=15, WSIG=ISPR, TBP=YES, TPI= NO, NOTE="AFX3   ",
TCL=6;
MGTCI:TSC=24, WSIG=ISPR, TBP= NO, TPI=YES, NOTE="ALTSPFA",
TCL=6;

***_TELECOMMUNICATION_SERVICE_ANALYSIS_DATA_***
*** GSM ***
MGTEI:TEC=AFX3,     TSC=15, TRI=T , ACC="14.4";
MGTEI:TEC=ALTSPFAX, TSC=24, TRI=T,  PSCVL=FRV1&FRV2,ACC="14.4";
```

Figure 8-11: Definitions for FAX in GSM (No support of circuit switched FAX in WCDMA)

```
***_TELECOMMUNICATION_SERVICE_CODE_DATA_***
MGTCI:TSC=16, WSIG=ISPR, TBP=YES, TPI= NO, NOTE="DA D NT", TCL=6;
MGTCI:TSC=17, WSIG=ISPR, TBP=YES, TPI= NO, NOTE="DA D  T", TCL=6;
MGTCI:TSC=27, WSIG=ISRE, TBP=YES, TPI=NO,  NOTE="DA UDNT", TCL=6;

***_TELECOMMUNICATION_SERVICE_ANALYSIS_DATA_***
*** GSM ***
MGTEI:BEG=DCDA,TSC=16,ITC=UDI,TRI=NT,FNUR="56.0",ACC="14.4"&"9.6"&"4.8";
MGTEI:BEG=DCDA,TSC=16,ITC=UDI,TRI=NT,CRT=FR-FR,URATE="4.8";
MGTEI:BEG=DCDA,TSC=16,ITC=UDI,TRI=NT,CRT=FR-FR,URATE="9.6";
MGTEI:BEG=DCDA,TSC=17,ITC=UDI,TRI=T,FNUR="14.4",ACC="14.4"&"9.6"&"4.8";
MGTEI:BEG=DCDA,TSC=17,ITC=UDI,TRI=T,CRT=FR-FR,URATE="4.8";
MGTEI:BEG=DCDA,TSC=17,ITC=UDI,TRI=T,CRT=FR-FR,URATE="9.6";

*** UMTS ***
MGTEI:BEG=DCDA, TSC=27, ITC=UDI, TRI=NT, SERVICE=BASIC, FNUR="38.4";
```

Figure 8-12: Definitions for asynchronous digital data calls (UDI, V.110)

```
***_TELECOMMUNICATION_SERVICE_CODE_DATA_***;
MGTCI:TSC=18, WSIG=ISPR, TBP=YES, TPI= NO, NOTE="DA A NT", TCL=6;
MGTCI:TSC=19, WSIG=ISPR, TBP=YES, TPI= NO, NOTE="DA A  T", TCL=6;

***_TELECOMMUNICATION_SERVICE_ANALYSIS_DATA_***
*** GSM ***
MGTEI:BEG=DCDA, TSC=18, ITC=AUD, TRI=NT, FNUR="28.8",
ACC="14.4"&"9.6"&"4.8";
MGTEI:BEG=DCDA, TSC=18, ITC=AUD, TRI=NT, CRT=FR-FR, URATE="4.8";
MGTEI:BEG=DCDA, TSC=18, ITC=AUD, TRI=NT, CRT=FR-FR, URATE="9.6";
MGTEI:BEG=DCDA, TSC=19, ITC=AUD, TRI= T, FNUR="14.4",
ACC="14.4"&"9.6"&"4.8";
MGTEI:BEG=DCDA, TSC=19, ITC=AUD, TRI= T, CRT=FR-FR, URATE="4.8";
MGTEI:BEG=DCDA, TSC=19, ITC=AUD, TRI= T, CRT=FR-FR, URATE="9.6";

*** UMTS ***
MGTEI:BEG=DCDA, TSC=18, ITC=AUD, TRI=NT, SERVICE=BASIC, FNUR="28.8";
```

Figure 8-13: Definitions for asynchronous analog data calls (MODEM)


```
**TELECOMMUNICATION_SERV.ANA.DATA_FOR_MULTI_SLOT_SERVICES**
MGMTI:  BEG=DCDA,TRI=NT,ITC=UDI,FNUR="56.0",
        ACC="14.4"&"9.6"&"4.8",MTCH=4,TSC=16 ;
MGMTI:  BEG=DCDA,TRI=NT,ITC=AUD,FNUR="28.8",
        ACC="14.4"&"9.6"&"4.8",MTCH=4,TSC=18 ;

MGMTI:  BEG=DCDA,TRI=T,ITC=UDI,FNUR="38.4",
        ACC="4.8"&"9.6"&"14.4",MTCH=4,TSC=17 ;
MGMTI:  BEG=DCDA,TRI=T,ITC=AUD,FNUR="28.8",
        ACC="14.4"&"9.6"&"4.8",MTCH=4,TSC=19 ;
```

Figure 8-14: Definitions for High Speed Circuit Switched Data calls (HSCSD)

TRANSMISSION MEDIUM REQUIREMENT ANALYSIS

Transmission Medium Requirement (TMR) analysis belongs to the Traffic Control Subsystem (TCS). This analysis is started when no BASC is available to determine a TSC value, the signaling and transmission capabilities. Therefore an estimated value defined for the incoming route (command ANRSI, parameter TMR) or a system defined default value is taken as input. TSC, TPI and TBP are obtained. Figure 8-16 illustrates this analysis.

Input to the analysis is:

- Transmission Medium Requirement (TMR)

Output of the analysis is:

- TSC used for charging and as pointer in TECA to:
  - Tone Protection Information (TPI)
  - Transmission Break Protection (TBP)

If TSC has no associated values for TBP and TPI, they receive default values.

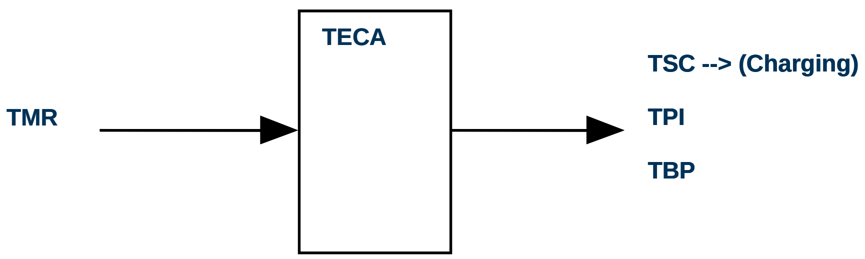


Figure 8-15: Transmission Medium Requirement Analysis

COMPATIBILITY CHECK

The Compatibility Check (CCH) is initiated by route analysis (command ANRSI, parameter CCH=YES). It determines whether or not the route is compatible for the service. Three cases exist:

- Outgoing Call
- Terminating BL Call
- Terminating MS Call

Figure 8-17 illustrates the Compatibility Check for an outgoing call.

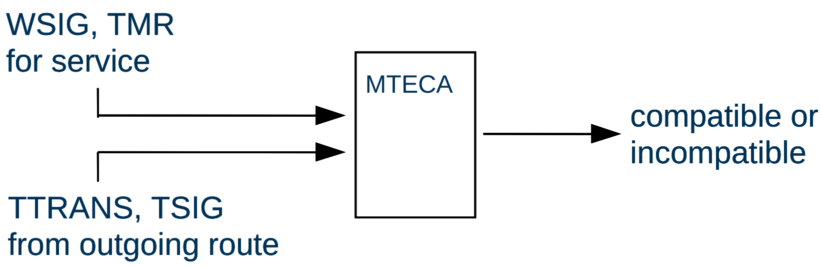


Figure 8-16: Compatibility Check (CCH) of Outgoing Calls

Input parameters are:

- WSIG - This parameter is the result of the BASC analysis for mobile originated calls.
  TMR - from originating side.
- Trunk Transmission Characteristic (TTRANS) - TTRANS is the transmission characteristic for the route obtained from route data (command EXROP).
- Trunk Signaling Capabilities (TSIG) - TSIG are the signaling capabilities of the route. TSIG is hard coded.
- Output of the analysis is:
- The call is compatible or not compatible.

In cases where the call is not compatible for this route, an alternate route is tried.

Intentionally Blank

9 Mobile Originating Call

Objectives

Highlight the analysis required for a mobile originating call as per the system documentation.

- Understand the basic principle of A-number analysis and A-number pre-analysis
- List the commands and the parameters in the A-number and A-number pre-analysis table
- Define Pre B-Number Analysis
- Configure the B-Number Analysis table.
- Understand the basic concept of access barring analysis and time supervision.
- Define access barring analysis and time supervision analysis tables
- Build the exchange data required to support calls from an MS/UE by interpreting exchange requirements.

Figure 9-1. Objectives

Intentionally Blank

INTRODUCTION

In this module, only the Data Transcript to support a mobile originated call will to be considered. Many of the areas of analysis, for example, B-number analysis, access barring analysis, and routing case analysis should be familiar from previous courses, so only the new or different aspects will be considered in more detail.

This module will involve the writing of data transcript in a number of different sub-files.

GENERAL

Figure below shows the nodes and information involved for a mobile originated call.

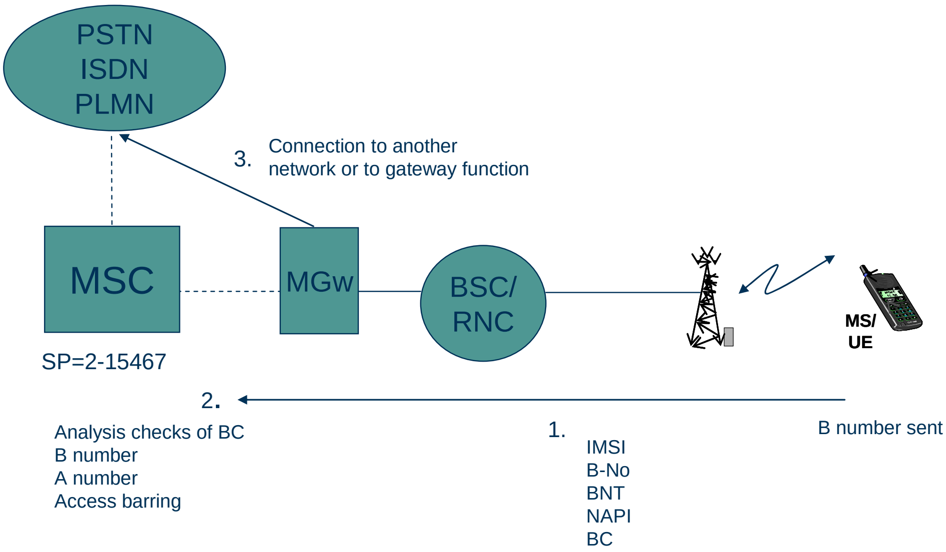


Figure 9-2: Call from MS/UE

The following sequence of events occurs:

1 The MS sends a DTAP message to the MSC-S Blade Cluster containing a Bearer Capability (BC), the B-number, along with other information describing the B-number. The other information includes the B-number Type (BNT) and the Numbering Plan Indicator (NAPI). The Bearer Capability (BC) describes the type of service required for the call. For example, it could be a telephony call, a fax call, a data call or even a short message call. The Numbering Plan Indicator (NAPI) always indicates that the B-number is based on the E.164 series, NAPI=1 and the B-number Type (BNT) usually indicates that the B-number is of an unknown type, BNT=2. However, if the ‘+’ key (the ‘+’ key is used instead of the international access code 00, that was internationally not unique) is used, BNT would indicate that the B-number was in the international format BNT=1.

2 A whole range of analysis takes place in the MSC-S as indicated in previous figure, before an outgoing route is selected.

3 The call would then be routed to other nodes or networks according to the B-number and Routing Case analysis. This could either be towards a PSTN or ISDN network or possibly towards a PLMN (GMSC).

This is a brief introduction to the mobile originating call. Figure 9-3 gives a more detailed illustration of the mobile originating call.

CALL FROM MS/UE

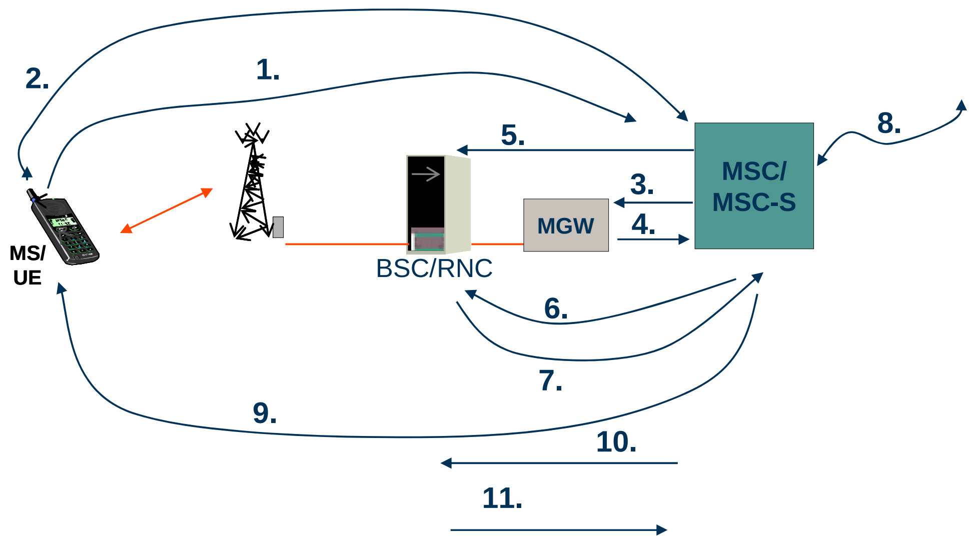


Figure 9-3: Call from MS/UE Detailed

1 The MS sends a SETUP message containing every necessary information (IMSI, B-number,…) to the MSC-S BC. The SPX node selected for this call setup choose a MSC Blade. This MSC Blade will check if its responsible for that subscriber. If not, will transfer to the correspondent MSC Blade to complete the call setup. Once the MSC Blade is identify, it the IMSI is analyzed in the VLR.

2 Authentication is performed by the MSC-S, if defined in the network. The ciphering is initiated and the IMEI is validated by the EIR.

Note: Ciphering and authentication are optional and are defined by the network operator. In the WCDMA Authentication mechanism, the quintuplet (RAND, XRES, CK, IK and AUTN) replaces the “triplet” (RAND, SRES, Kc). Every Authentication is performed using fresh quintuplets. The Ciphering Key (CK) is increased in length compared to the GSM Ciphering Key (Kc). To provide security of the signaling between the user and the MSC/MSC-S, a function known as Signaling Integrity Protection is introduced with a new information element, Integrity Key (IK). The new Authentication Token (AUTN) is also introduced. The XRES replaces SRES in WCDMA Authentication and has the same function as SRES in GSM. RAND has the same function as in GSM.

See additional information for authentication process by using the parameters listed in the command MGEPP.

3 The MSC-S receives a set-up message from the MS/UE. Included in this information is the type of service the MS/UE wants and the number (called the B-number) dialed by the mobile subscriber. The MSC-S checks that the mobile subscriber does not have services, such as barring of outgoing calls activated. (Barring can be activated either by the subscriber or by the operator.) If the mobile subscriber is not barred, the setting up of the call proceeds. In order to complete the call, the MSC-S can already seize all required resources by sending a SEIZE RESOURCE message to the MGW. The MGW selection vary depends on traffic case and configuration data.

4 The MGW returns an ACKNOWLEDGE message to the MSC-S. All the necessary resources in MGW are reserved.

5 The MSC-S informs the BSC/RNC that the call setup is proceeding with a CALL PROCEEDING message.

6 The MSC-S requests the BSC/RNC to set up a connection to MGW with an ASSIGNMENT (BSSAP) / RAB ASSIGNMENT REQUEST (RANAP) message.

7 After the connection set up complete, the BSC/RNC informs the MSC-S with ASSIGNMENT COMPLETE (BSSAP) / RAB ASSIGNMENT RESPONSE (RANAP) message.

8 The traffic control subsystem (TCS) in the MSC-S Blade Cluster analyzes the digits and sets up the connection to the called subscriber (ISDN, PSTN or another PLMN) via a corresponding TSC Blade. In this case, the MSC Blade sends via INTRO route to the TSC Blade and it will set up the connection towards the next node/network (ISUP or BICC route).

9 Once all the necessary resources to the called subscriber are reserved, an ALERTING message is sent to the MS/UE, indicating that a ringing tone has been generated on the B-subscriber side. The tone generated in the exchange on the B-subscriber side is sent to the MS/UE via the Group Switch (GS) in the MSC or via GCP protocol to inform MGW to generate the tone. This means that it is sent over the air, not generated in the MS.

10 When the B-subscriber answers, the TSC Blades sends it to the MSC Blade and the MSC Blade sends a CONNECT message to the MS/UE to indicate that the call is accepted.

11 The BSC/RNC sends back an ACKOWLEDGEMENT message to the MSC-S. The connection between the A-subscriber and the B-subscriber is now activated. The GSM/WCDMA system speech call can now take place.

ANALYSIS FUNCTIONS

For a mobile originated call to be routed, a number of analysis functions are required. A general analysis diagram is show below. This is applied for MSC and TSC blades. Except IMSI Origin Analysis is not done in TSC Blades.

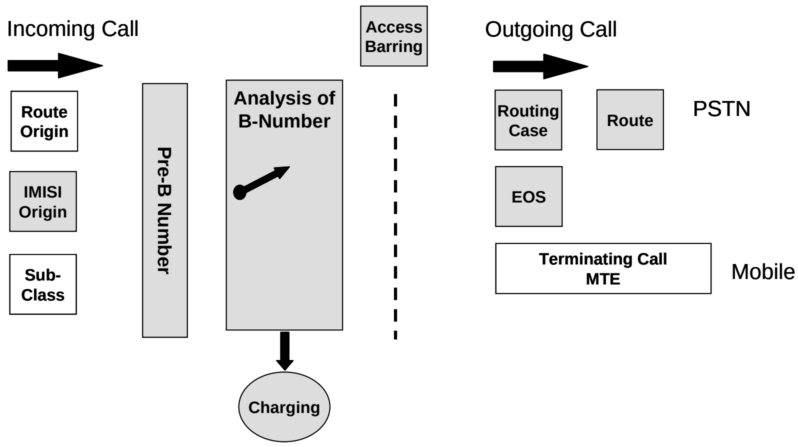


Figure 9-4: Analysis Functions

TELECOMMUNICATION SERVICE ANALYSIS

The telecommunication service analysis was covered in the previous chapter 9 - ‘Telecommunication Service Analysis’. A summary is shown in the next Figure.

The purpose of the telecommunication service analysis is to determine whether or not the MSC/VLR supports this type of call. If the MSC/VLR does not have a DTI, any data or fax call would fail because the DTI is necessary in order to support the call.

The GSM or WCDMA Bearer Capability from the MS is converted into Basic Service Codes (BASC). The BASC is then analyzed. If this requested service is not supported in the MSC/VLR, the BASC for this service would not be defined in MTECA. The call would then fail. If the call is supported, the requirements etc. for the call would be obtained.

The Data Transcript for the Telecommunication Service Analysis function would normally be a standard set of data, which would be used from one switch to the next. Maybe slight editing would be needed.

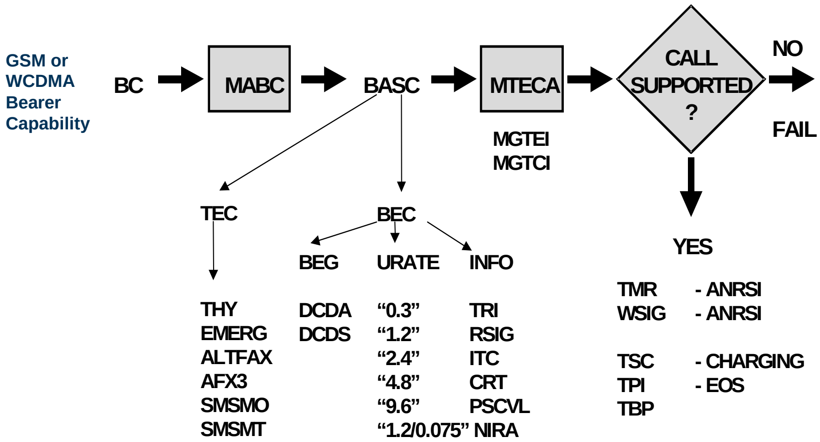


Figure 9-5: Telecommunication Service Analysis

If the requested service is supported, the call can proceed with checks on the IMSI, the B-number and the subscription checks.

IMSI NUMBER SERIES ANALYSIS

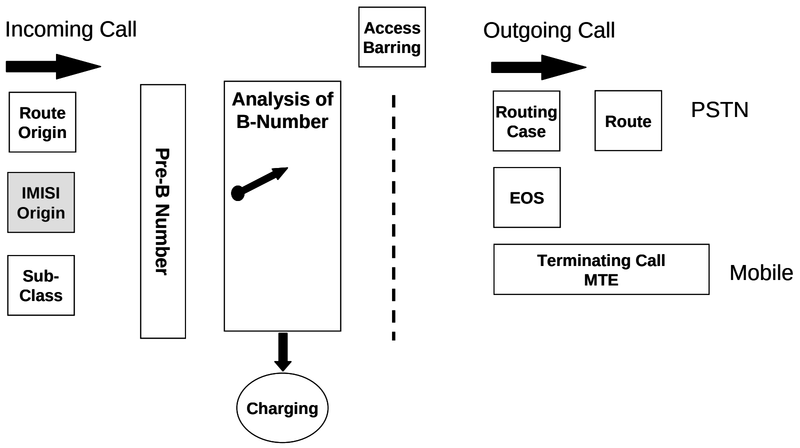


Figure 9-6: IMSI Number Series Analysis

Information about the MS/UE is fetched from the IMSI number series analysis (the MGISI command) table defined in all MSC Blades. This information includes the following parameters:

OBA

Origin for B-number Analysis - specifies which B-origin the MS/UE is to use for the mobile originated call.

CBA

Call Barring Access is used in connection with the BOIEXH supplementary service (Barring of all Outgoing International calls Except those directed towards the Home PLMN),

NATMS

National Mobile Subscriber is used to determine how the A-number is presented. The default is in the International format, but this parameter puts the A-number in the National format.

OWNMS

OWN Mobile Subscriber is used to identify the subscriber as one that belongs to this PLMN, that is, this is the subscriber's HPLMN.

CBAZ

This parameter, Call Barring Access for Inter-Zonal Calls except those directed to the HPLMN country, is mandatory. It is used for the operator determined barring of inter-zonal calls and indicates whether the call is to be barred or not depending on its destination.

STALL

This parameter stands for Subscription Type Allowed. It indicates whether or not the subscription type stored in the VLR can be used. This is an optional parameter.

All of these parameters are defined using the ANRES parameter. A copy is found in the Application information for Mobile Telephony Data. To find the parameter values to use or to get an explanation of the parameter, the Application Information for the parameter-owning block needs to be looked at, for example, the owning block for NATMS is MTACC (for a mobile originated call) or MTBSS (for mobile terminating calls).

B-NUMBER ANALYSIS

The B-number analysis is central to the whole call setup process as shown in the figure below.

It is recommended to define the most common data transcript for B-number table analysis for MSC and TSC Blades. Although some data are different such as routing a call to a PSTN, incoming call from an another PLMN and so on.

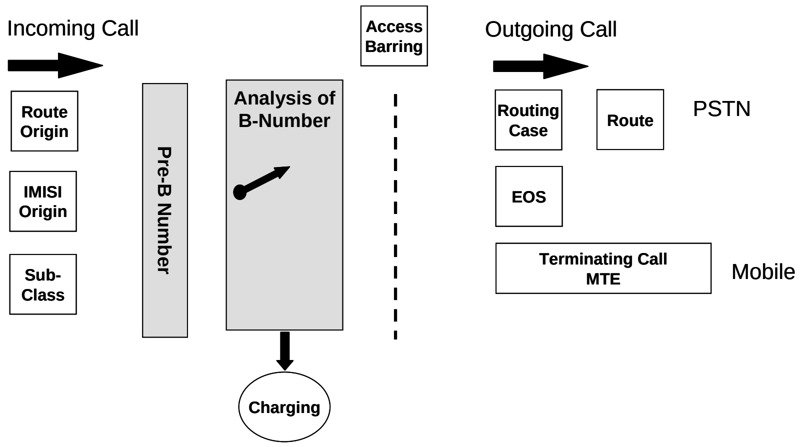


Figure 9-7: B-Number Analysis

The B-number analysis is carried out in two stages. The first stage is referred to as a Pre-analysis of the B-number and then the analysis of the B-number takes place.

The pre-analysis acts as a filter and then as a selector. Due to the pre-analysis, it is possible to reduce and simplify the number of origins used in the B-number analysis tables.

Pre-analysis of the B-number

The pre-analysis table makes use of the extra information contained in the set-up message originating from the MS: the B-number Type (BNT) and the Numbering Plan Indicator (NAPI). These parameters are generated by the MS/UE or the ISDN equipment, and are then transferred from network to network using the ISUP protocol. An explanation of these parameters, BNT and NAPI, is found in Figure 9-8.

NAPI: 0 SPARE
1 ISDN/PSTN (E.163/E.164)
2 DATA (X.121)
3-15 SPARE

BNT: 0 RESERVED
1 INTERNATIONAL
2 UNKNOWN
3 SUBSCRIBER
4 NATIONAL
5-15 SPARE

Examples:

009 46 70 533	BNT=2 Unknown format, dialed number
070 533	BNT=2 Unknown format, dialed number
533	BNT=3 Subscriber format, SN
46 70 533	BNT=1 International number, CC+NDC+SN
70 533	BNT=4 National number, NDC+SN

Figure 9-8: NAPI and BNT Parameter Values

By using the extra information about the B-number it is possible, for example, to direct an international number directly to a B-origin containing only numbers in the international format. Figure 9-9 shows an example of this.

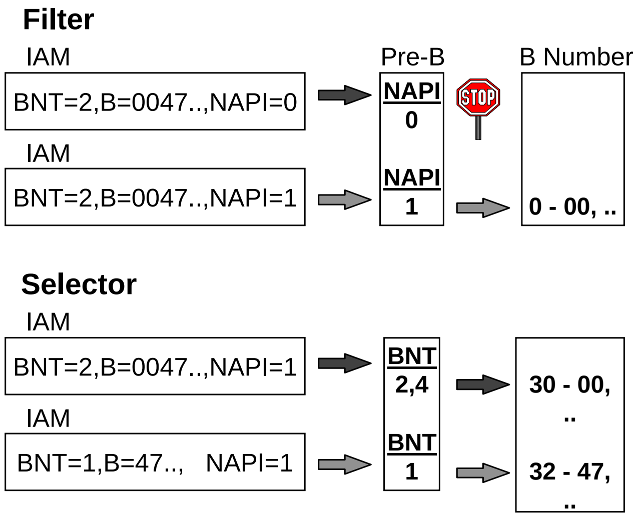


Figure 9-9: Use of Pre B-Number Analysis

Figure 9-9 shows that the pre-analysis can act as a filter, by using the NAPI value and as a selector by using the BNT value.

Using Figure 9-9, the parameter NAPI is used as an example of pre-analysis acting as a filter. If NAPI=0, then the analysis stops and goes no further, because it is a spare number plan. However, if NAPI=1, the analysis of the B-number would continue in the origin indicated.

The NAPI and BNT parameters can then be used as selectors, for example: If BNT=2 (unknown number type) and NAPI=1 (E.164 number format), which would be the usual case from the MS/UE, the pre-analysis directs the analysis to continue in origin 30. However, if BNT=1 (international) and NAPI=1, which would be generated if the '+' key is used, then the analysis would continue in origin 32. Origin 32 contains the international (country code) numbers.

The other thing to notice when BNT=1 is that the B-number does not contain 00. In this case the digits 00 are the international prefix.

Analysis of the B-number

Figure 9-10 describes the type of calls each B-origin supports. From the example shown in the figure below, only origins 30 and 32 are of interest regarding a mobile originated call.

Origin 30, in our example, is where all MS originated calls would be sent if they had a BNT value of 2 (unknown). Origin 32 would only be used for international calls having a BNT value of 1 (international); this selection would have been determined in the pre-analysis.

Note: MS/UE only generates BNT values of 2 or 1; it is not able to generate a number in national format (BNT=4).

```
!********************************************************!
!****       USED ORIGINS IN B-NUMBER ANALYSIS       ****!
!********************************************************!
!*                                                      *!
!*                                                      *!
!*   B=1       INCOMING # FROM MSC1 NAT. AND INT.      *!
!*   B=8-9     ROAMING # AFTER INTEROGATION            *!
!*   B=30      ORGINATING CALLS FROM MS                *!
!*   B=32      INTERNATIONAL CALLS                     *!
!*   B=40      BL ORIGINATING AND TERMINATING CALLS    *!
!*   B=90      AIRTIME CHARGING                        *!
!*   B=93      MSMO CHARGING                           *!
!*   B=94      MSMT CHARGING                           *!
!*   B=99      ANSWERING MACHINE                       *!
!*                                                      *!
!********************************************************!
```

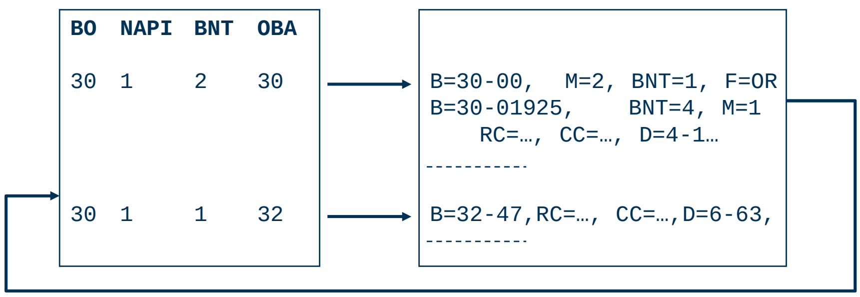
Figure 9-10: Use of B-origins

B-Origin 30

B-origin 30 will have to contain all the number series that can be expected from the MS/UE. However due to the pre-analysis, only numbers of an unknown type (BNT=2), will need to be defined. This would include calls directed to the PSTN, which usually have a national 0-prefix. Emergency calls also need to be considered, for example, both the national emergency number and the GSM/WCDMA emergency number (112). This analysis should present the number in a national format and set the BNT accordingly (BNT=4).

B-Origin 32

B-origin 32, in our example, will contain all numbers in the international format, that is, beginning with a country code. Again, this would have been achieved through the use of pre-analysis when BNT=1. Remember that it is the mobile which has generated the value of BNT=1. In reality this table would need to include **all country codes in the world**.




```
EXAMPLE 1
BO=30, NAPI=1, BNT=2, B=30-0047…

EXAMPLE 2
BO=30, NAPI=1, BNT=1, B=32-47…

EXAMPLE 3
BO=30, NAPI=1, BNT=2, B=30-01925…
```

Figure 9-11: Examples of B-Number Analysis

Figure 9-11 shows how B-number analysis works using three examples.

EXAMPLE 1

The BO parameter has been received from the IMSI Number Series Analysis (the OBA parameter in the MGISI). However, the BNT and NAPI parameters and the B-number are received as part of the SETUP message from the MS.

The number plan is specified in the E.164 series (NAPI=1) and the B-number from the MS/UE is of an unknown type (BNT=2). The B-number starts with the digits 00 (international prefix digits), indicating that access to the international network is required.

It can be seen from pre-analysis, that the B-number is to be analyzed in origin 30 (result: OBA=30). In origin 30, 00 is identified with the following outcomes:

1. Remove the first 2 digits (M=2),
2. Change the number type to be international (BNT=1),
3. Return to the original origin in pre-analysis (F=OR) for further analysis. Here the NAPI and BNT parameter values are re-analyzed and their explanation continues with example 2.

EXAMPLE 2

The BO parameter has been received from the IMSI Number Series Analysis (or from B-origin 30 if following on from example 1), whilst BNT, NAPI and the B-number have been received as part of the SETUP message from the MS.

The number plan is that specified in the E.164 series (NAPI=1), the number from the MS/UE is of an international type (BNT=1), and the B-number starts with the digits 47, a Country Code.

In pre-analysis with BNT=1, the analysis of the B-number is to continue in origin 32 in the B-number analysis table. In origin 32, 47 is the number series identified, at which point a routing case (RC), the charging case (CC) and an access barring parameter (D) are identified (in this example). An explanation of these parameters will take place in the following sections.

EXAMPLE 3

The BO parameter has been received from the IMSI Number Series Analysis, whilst BNT, NAPI and the B-number have been received as part of the SETUP message from the MS.

The number plan is that specified in the E.164 series (NAPI=1). The number from the MS is of an unknown type (BNT=2), and the B-number starts with 0 (national prefix), indicating that the call is a national PSTN call.

The pre-analysis selects origin 30 for the B-number to be analyzed. The outputs for the number series 01925 are to:

1. Remove the 0 (M=1).
2. Change the number type to national (BNT=4).
3. Identify which access barring table to use (D=4-1) for any of the call barring supplementary services.
4. Identify a charging case (CC) to be used in the initial charging analysis.
5. Assign a routing case (RC) for the call to be routed to the PSTN.

Parameters used with ANBSI

Figure 9-12 shows some of the important parameters that are to be used with the ANBSI command. There are many more parameters; for more information (the meaning and use) regarding the parameters. See the COD and ADI.

Main parameters for ANBSI

L	**Length, number of digits expected**
F	**Analyze digits in a new origin from the FIRST digit**
N	**Analyze digits in a new origin from the NEXT digit**
RC	**Routing Case**
CC	**Charging Case**
M	**Modify the B-number**
BNT	**B-Number Type**
NAPI	**Number Plan Indicator**
D	**Access Barring**
AW	**A-number Wanted**
CW	**A-subscriber Class Wanted**
MTE	**Mobile Terminating Call**
TE	**Terminating Call**
EAP	**Equal Access Prefix**
CIC	**Carrier Identification Code**
ISTI	**IN Service Trigger**

Figure 9-12: B-Number Table Parameters

L - Length

This parameter specifies the number of digits that **arrive** in the exchange. If the exact value is not known, a range should be specified, for example, L=10-14.

F - First digit

If a number needs to be analyzed in another origin starting with the first digit, this parameter would be used, if **all the digits** need to be analyzed. The parameter is usually used in conjunction with the modification parameter M. If F=OR, the analysis goes back to the original origin in the pre-analysis table.

N - Next digit

If a number needs to be analyzed in another origin from the **next digit**, this parameter would be used.

RC - Routing Case

This specifies the Routing Case and will be the input into Routing Case Analysis. This parameter would end any further analysis of the B-number unless there is a F or N parameter used.

CC - Charging Case

This specifies the Charging Case and will be the input into charging analysis.

M - Modification

This parameter allows a received number to be modified. This could be the removal of some digits, or the addition of some digits, or the removal **and** addition of some digits. The modification starts with the first digit received. Examples: the removal of some digits is M=**3**, addition of some digits is M=0-**123** and the removal and addition is M=**1-44**.

BNT - B-Number Type

If the signaling system used to transfer the B-number does not allow the Type Of Number (TON) to be transferred, the default value is of type ‘unknown’ (BNT=2). After analysis it is possible to change this value to reflect the actual number. If the number is also modified, BNT should be inserted to reflect the change. The value of this parameter will stay with the B-number throughout the call.

NAPI - Numbering Plan Indicator

This parameter works in the same way as the BNT but determines the numbering plan being used, for example E.164.

D - Access Barring

Access Barring is used to determine whether or not a subscriber is allowed to make a particular type of call, for example an outgoing international call. This parameter points to another table where further analysis takes place.

AW - A-number Wanted

If the A-number is not transferred as part of the signaling system and is required, this parameter should be used. It is often used when routing a call to the gateway function (route GRI).

CW - A-number Class Wanted

If the A-numbers class is not transferred in the signaling system, but is required, this CW parameter should be specified. Again this would be used when routing to the GRI.

MTE - Mobile Terminating Call

This parameter is used to identify the received number as an MSRN. The parameter can only be used when the MSRN is analyzed to the hundreds group that is, MSRN in national format.

TE - Terminating Call

This parameter is used to terminate a call to a locally connected subscriber, for example a BL test phone.

EAP - Equal Access Prefix

Equal Access Prefix is part of the carrier access code and is used to indicate that a carrier identification code (CIC) follows at the start of the called number.

This parameter indicates that an equal access prefix was dialed. Digit string 1 - 3 digits. Each digit is 0 - 9.

The availability of this parameter depends on commercial agreements.

CIC - Carrier Identification Code

Carrier Identification Code is part of the carrier access code and is used to identify an inter-exchange carrier (IXC). This parameter contains the carrier identification code of the dialed carrier. Digit string 1 - 6 digits

Each digit is 0 - 9.

ISK - IN Service Key

This parameter is explained here but will not be used. The parameter is used to identify that the call requires access to the IN node. This value is used as a branching parameter in RC analysis.

ACCESS BARRING ANALYSIS

The access barring analysis is defined in the MSC and TSC Blades.

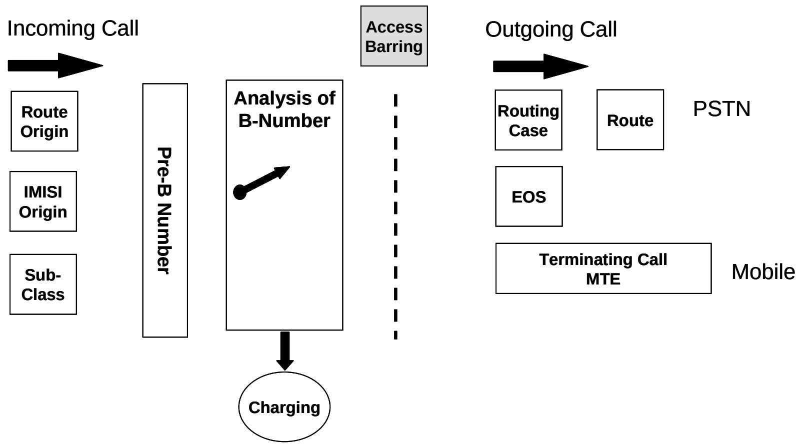


Figure 9-13: Access Barring Analysis

Access barring analysis is the method of determining whether an MS is permitted to make a call. It works in conjunction with the call barring (BAOC, BOIC, BOIEXH) or operator determined barring (OBA, OBI, OBO, OBOPRE, OBOPRI, OBZO, OBZI, OSB1, OSB2, OSB3, OSB4) supplementary services.

This function is invoked by the use of the D parameter from the analysis of the B-number and points to a table for access barring. The meaning of the D parameter can be found in the application information for block DA. For each table, a number of Traffic Destination Classes (TDCL) exist. The TDCL value is compared to the Calling Barring Access (CBA) value: if they are equal then the call will fail and if they are not then the call can proceed Figure 9-14 shows an example of this.

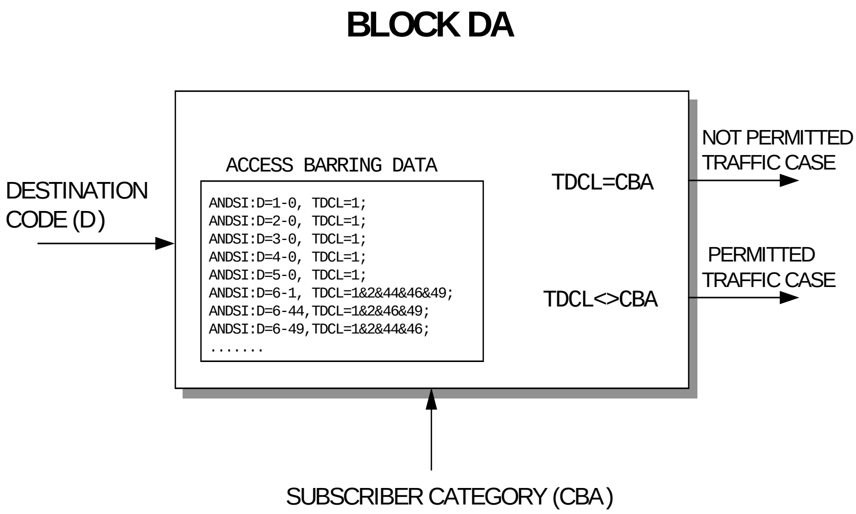


Figure 9-14: Example of Access Barring Analysis

The following call barring and operator determined barring supplementary services (BOAC, BOIC, OBO, OBOPRE, OBOPRI, OSB1, OSB2, OSB3 and OSB4) have a CBA value defined in the parameter list of block MTV, Figure 9-15 gives an example for the supplementary services BOAC, OBO-1, BOIC & OBO-2.

```
NSYMB  CBAVALUE0     = 0;! CBA VALUE FOR ALL BARRING  !
                         ! SERVICES INDICATING NO     !
                         ! BARRING                    !
                         ! VALUE RANGE 0...63         !
                         ! GUIDING VALUE = 0          !
                         ! 1 = OPERATOR DETERMINED    !
                         ! BARRING OF ALL OUTGOING    !
                         ! CALLS IS ACTIVE            !
NSYMB  CBAVALUEBAOC  = 1;! CBA VALUE FOR  OPERATOR    !
                         ! DETERMINED BARRING OF ALL  !
                         ! OUTGOING CALLS AND BARRING !
                         ! OF ALL OUTGOING CALLS      !
                         ! SUPPLEMENTARY SERVICE      !
                         ! VALUE RANGE 0...63         !
                         ! GUIDING VALUE = 1          !
                         ! 1 = OPERATOR DETERMINED    !
                         ! BARRING OF ALL OUTGOING    !
                         ! CALLS IS ACTIVE            !
NSYMB  CBAVALUEBOIC  = 2;! CBA VALUE FOR OPERATOR     !
                         ! DETERMINED BARRING OF ALL  !
                         ! INERNATIONAL OUTGOING CALLS!
                         ! AND BARRING OF ALL OUTGOING!
                         ! INTERNATIONAL CALLS        !
                         ! SUPPLEMENTARY SERVICE      !
                         ! VALUE RANGE 1...63         !
                         ! GUIDING VALUE = 2          !
                         ! 2 = OPERATOR DETERMINED    !
                         ! BARRING OF ALL OUTGOING    !
                         ! INTERNATIONAL CALLS IS     !
                         ! ACTIVE                     !
```

Figure 9-15: Example of CBA Values

The supplementary service BOIEXH uses the CBA value defined with the MGISI command (IMSI number series analysis). The network operator determines this value; values 13 to 255 are available for use. This supplementary service is defined by ETSI in the GSM/WCDMA recommendations and must therefore be provisioned.

The supplementary service regarding Barring of Inter-zonal calls except to the HPLMN, uses the CBAZ value defined with the MGISI command.

Figure 9-16 shows an example of the access barring function working.

```
MGISI:IMSIS=23415, ......, ANRES=OBA-30&CBA-63;
MGISI:IMSIS=26202, ......, ANRES=OBA-30&CBA-62;

PNBSI:BO=30, NAPI=1, BNT=2, OBA=30;
PNBSI:BO=30, NAPI=1, BNT=1, OBA=32;

ANBSI:B=30-01925, D=4-1, ......... ;
ANBSI:B=32-44, D=6-63, ............. ;
ANBSI:B=32-49, D=6-62, ............. ;

ANDSI:D=4-1,TDCL=1;
ANDSI:D=6-62,TDCL=1&2&63;
ANDSI:D=6-63,TDCL=1&2&62;
```

Figure 9-16: Access Barring Analysis MML Commands Required

Below are four examples of access barring using the data shown in Figure 9-16.

EXAMPLE 1 - BOIEXH

A MS whose IMSI begins with 23415 and has the BOIEXH supplementary service **active** (BOIEXH-1) makes an international call beginning with a country code of 49. The B-number analysis gives D=6-62. When the TDCL values from that access barring table are found, it can be seen that a TDCL value (TDCL=63) exists which is **equal to** the CBA value (CBA=63) for the MS. In this instance the **call fails** as the MS is barred from this type of call.

EXAMPLE 2 - BOIEXH

A MS who's IMSI begins with 26202 and has the BOIEXH supplementary service **active** (BOIEXH-1) makes an international call beginning with a country code of 49. The B-number analysis gives D=6-62. When the TDCL values from that access barring table are found, it can be seen that no TDCL value exists which is equal to the CBA value (CBA=62) for the MS. The **call can proceed** in this instance.

EXAMPLE 3 - BOIC/OBO-2, INTERNATIONAL

From Figure 9-15, it can be seen that the supplementary service BOIC and OBO-2 has a CBA value of 2 (CBAVALUEBOIC=2). Therefore, if an MS with the services BOIC or OBO-2 active makes **any international call**, there will be a match between the CBA value and a TDCL value in the access barring table. The call will therefore **fail.**

EXAMPLE 4 - BOIC/OBO-2, NATIONAL

If the MS/UE in example 3 were to make a national PSTN call, access barring table 4-1 would be selected. In this instance there would not be a match between the CBA value and a TDCL value. This makes the call to **proceed.**

It is important to include the correct D parameter, in the B-number analysis table; otherwise the barring of specific call types would fail to work correctly.

TIME SUPERVISION

All networks have a so-called "numbering plan". Numbering plans are prepared for the international network, national networks, and regional networks.

Within each area, the numbering plan connects a defined number series to a specific exchange. In some networks, a fixed number length is used. In other networks, the length of the subscriber number may vary.

When setting up a call to a remote network, perhaps in another country, the number length might be unknown. Usually, the maximum and the minimum length of the number is known. In the B-number analysis, the parameter L is set to 8-10 for example. This means that the length of the expected B-number is at least 8 digits and not more than 10. What should the exchange do when 8 digits have been received from the subscriber? Should more digits be entered, or has the last digit been received? The only way to determine this is by measuring the time it takes for the subscriber to dial the next digit. In normal cases, the time supervision between the digits is set to some 15-30 seconds. If we reduce this time to about 5 seconds, the exchange will know when the last digit is dialled. If no more digits are entered after the 5 seconds, it is assumed that the last digit has been dialled.

TIME SUPERVISION ANALYSIS TABLE

When a time supervision analysis should be performed, the parameter TI is delivered by the B-number analysis.

The time supervision analysis is used in two cases:

1. The number length is not known and it is wished to use the time supervision to determine this. That is, if no digits arrive within a certain time, the whole number is considered received. Alternatively, the time supervision can be disconnected and information received from another exchange that the whole number has been received.

2. There are two numbers (e.g. 0 and 01) containing routing in different directions. The only way of separating these is to use the time supervision. If time release is obtained after 0, the number is regarded as 0. (An EOS-case must be specified). If, on the other hand, the one arrives before time release 01 is considered received.

In both of the above cases the time supervision period can be decreased (DTS is specified). The actions may be dependent on origin.

A basic principle is that origin 0 applies to subscribers who dial digits directly into AXE, that is, subscribers at home exchange and subscribers at subordinate registerless exchanges. To other subscribers the normal origin 1 applies. In all, 4 origins may exist.

- The applicable time supervision case is indicated from the B-number analysis. If nothing has been indicated, TI=0 is applied, which should be used as normal case.

- The time supervision analysis is called only in the case when an unknown number length has been specified in the B-number analysis. Example L = 8-9 (Min. 8 - Max. 9).

- If time release is obtained before minimum number length has been reached, it will be considered a fault. The action is to be specified in the end-of-selection analysis.

- An unspecified time supervision case gives the same analysis result as if the following had been written:

```
           /
           |Origin ---> 0       1       2       3
ANTSI:TI=X+
           |Action --->NTS:   NTS:   NTS:   NTS;
           \
```

  This involves that if it is not desired, for any origin for time supervision, to deviate from the normal time supervision (NTS), no time supervision case is to be specified.

- If both the time supervision case and the number length are indicated on the same digit, then first the analysis result number length is obtained and after that the time supervision case. This means that if the time supervision analysis has already been in and for example decreased the supervision time because an earlier indicated minimum number length has been reached, this analysis result will apply until a new minimum length is reached. If a fixed number length has been specified, the time supervision is applicable until this is reached. To actions which are to be taken on the occurrence of time release, however, the new time supervision case applies.

Figure below shows an example of a time supervision analysis table.

```
<ANTSP:TI=ALL;

TIME SUPERVISION ANALYSIS DATA
TI     ES      TSRES(TO 0-3)
0              NTS     NTS     NTS     NTS
1              DTS     NTS     NTS     NTS
2              NTS     DTS     DTS     DTS

END
```

Figure 9-17 Example of Time Supervision Analysis.

COMMANDS AND PARAMETERS

For specifying a time supervision case the command ANTSI is used. In order to change a time supervision case which has been introduced earlier, the whole specification is made once again with command ANTSI.

For removing an earlier introduced time supervision case the command ANTSE is used. A time supervision case should not be erased if any reference to the time supervision case exists in the B-number analysis. However there is no automatic check of this, so if ANTSE is given the time supervision case is erased anyway, and then normal time supervision is used.

ANTSI

This command specifies the result of a time supervision analysis for a time supervision case with an indication of the measures for all four origins for the analysis. A time supervision analysis can be used for determining a number length, in those cases in which the number length is unknown, or for routing in conjunction with similar number series, for example 0 and 01.

An unspecified time supervision case gives the analysis result "normal time supervision" for all origins.

```
                         /      \/      \/      \
                    /   \| /   \|| /   \|| /   \|
                    |NTS|| |NTS||| |NTS||| |NTS||
ANTSI:TI=ti[,ES=es],+DTS+|:+DTS+||:+DTS+||:+DTS+|;
                    |BTS|| |BTS||| |BTS||| |BTS||
                    \   /| \   /|| \   /|| \   /|
                         \      /\      /\      /
```

Figure 9-18 ANTSI Command.

TI=ti — Time supervision case. (Numeral 0-15)

Specifies number on the time supervision case. Time supervision case 0 constitutes the normal case.

ES=es — End of Selection Case (Numeral 1-9999)

End-of-selection case with measures specified in the end-of-selection analysis. Used for routing after time release.

NTS — Normal Time Supervision.

DTS Decreased Time Supervision.

BTS Break Time Supervision.

NTS, DTS and BTS specify the relevant time supervision for the respective origins. The length of the supervision period is specified in function blocks for incoming device routes.

Time supervision origins 0-3 can be specified.

ANTSE

This command is used to remove a time supervision case.

If the case is pointed out after removal, the result "normal time supervision" applies to all analysis origins.

ANTSP

This command initiates a printout of data for a specified time supervision case.

DT EXAMPLE OF TIME SUPERVISION ANALYSIS

A simple DT example of time supervision analysis is shown in

Figure 9-19.

```
!-------------------------------------------------------------!
  ANTSI:TI=0, NTS;        ! TIME SUPERVISION OF B-NUMBER ANALYSIS !
!                           IN CASE OF UNDEFINED NUMBER LENGTH    !
!-------------------------------------------------------------!
```

Figure 9-19 DT Example of Time Supervision Analysis.

ROUTING CASE ANALYSIS

Another output from the B-number analysis table is the routing case (RC). This parameter is analyzed further in the Routing Case Analysis Table to determine the outgoing route for the call to proceed. The outgoing route must already have been defined with the EXROI and EXRBC commands.

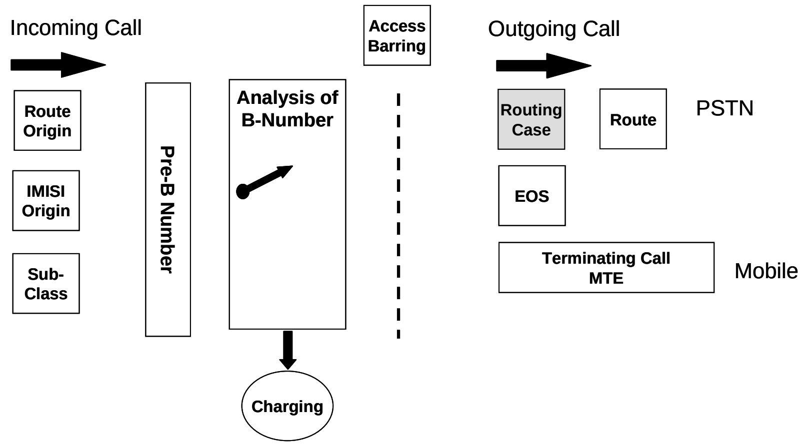


Figure 9-20: Routing Case Analysis

Figure above shows the command and the important parameters that are used to define the routing case analysis.

Command: ANRSI

Parameters:	**RC**	**Routing Case**
	CCH	**Compatibility check**
	R	**Route**
	ES	**End of Selection**
	SP	**Sending Program**
Important branching:	**TMR**	**Transmission Requirements**
	EA	**Emergency area**
	RA	**Percentage random switch**
	WSIG	**Wanted Signal**
	PLMN	**PLMN of subscriber number**
	RO	**Route Origin**
	ISTI	**IN Service Trigger Indication**

Figure 9-21: Routing Case Analysis Parameters

CCH - Compatibility Check

The compatibility check parameter is used to compare the requirements for the service (which have been obtained from the telecommunication service analysis) to those offered by the outgoing route. If the outgoing side does not meet the requirements for the service then the call will be terminated. This parameter **defaults to YES** but should not be applied to non-circuit routing.

Check the Application Information for the route owning block to see whether CCH=YES or CCH=NO.

SP - Sending Program

The sending program determines:

1. on which digit received a device is to be seized,
2. on which digit received a seizure signal is to be sent,
3. from which digit to send to the next exchange.

For example SP = 441, implies (1) that on the forth digit received a device is seized (2) on the forth digit a seizure signal is sent and finally (3) we send the digits from the first one received (all the digits are sent).

In many cases, a value **M** exists which means only when all the digits have been received would you seize a device or send a seizure signal.

TMR - Transmission Requirements

The transmission requirements are determined in the telecommunication service analysis. They detail the demands on the network to provide certain characteristics for the call. If the network cannot meet them, then the call will fail. The values and meaning of the TMR can be found in the COD for ANRSI.

The TMR parameter is used as a branch condition and is used to determine whether echo cancellers are required for the call.

Note: Only speech calls require echo cancellers; data calls do not (a data call requires the DTI to support the call).

EA - Emergency Area

The emergency area is allocated on a per cell basis, with the MGCEC command. The parameter is used to route emergency calls to the correct emergency service center.

WSIG - Wanted Signaling

This parameter is an output from telecommunication service analysis and identifies whether or not ISDN signaling is required for the call.

PLMN - PLMN of the Subscriber Number

The value of this parameter is determined in the IMSI Number Series Analysis, based upon the IMSIS. The value can be used to branch to an announcement in the subscriber's own language.

RO - Route Origin

This value is set on the incoming route with the EXRBC command or to a cell with the MGCEC command. The parameter will allow the calls from different cells or incoming routes to be routed in different ways.

ISTI - IN Service Trigger Indication

The value of this parameter has been determined in B-number analysis. Different ISTI values will identify different IN services and as a consequence different routing will be required.

IGWT – Incoming Access MGW Type

This parameter is used only in the Combined MSC Node. The value of the parameter identifies the type of the MGW at incoming side. The availability of this parameter value depends on commercial agreements.

Examples of Branching

Routes, which are connected to hardware leading to other exchanges or routes to announcements, need to be defined with a routing case. Also, certain functions requiring access via a software route also need to be defined with a routing case, for example, the interrogation of the HLR requires access to the GRI route.


```
ANRPI:RC=1;
ANRSI:BR=TMR-0,  P01=1,R=PSTNO,ESS=0,ESR=1,SP=771;
ANRSI:BR=TMR-1&&-4,   P02=1,R=PSTNO,ESS=0,ESR=0,SP=771;
ANRPE;
!EXTERNAL ROUTE, TMR USED TO SELECT ECHOCANCELLERSOR NOT !

ANRPI:RC=100;
ANRSI:BR=TMR-0,P01=1,R=TRACK1,SP=330;
ANRSI:P01=2, R=TRACK11, SP=330;
ANRSI:P01=3, ES=114;
ANRSI:BR=TMR-1&&-4,P02=1, ES=114;
ANRPE;
! ANNOUNCEMENT ROUTE, 'OUT OF SERVICE / POWEROFF' !

ANRSI:RC=60, R=0GRI2, CCH=NO, SP=MM1, BNT=1;
! ROUTE TO HLR !
```

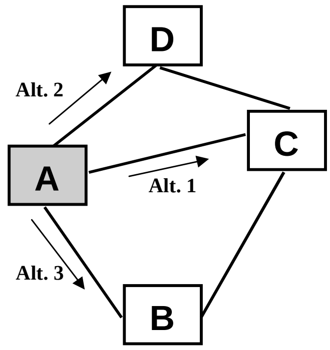
Figure 9-22: Routing Case Analysis Examples

The examples shown in Figure 9-19 illustrate the flexibility of routing case analysis. The first example, RC=1, uses the parameter Transmission Medium Requirement (TMR) value to decide whether an echo canceller is required for the call. For speech calls (TMR-0) they are required (ESR=1) but for fax and data calls (TMR-1&&-4) they are not (ESR=0). The use of the sending program parameter (SP) is also illustrated as is the need for a procedure when entering multiple lines within one routing case. For a procedure the additional commands ANRPI (to start the procedure) and ANRPE (to end the procedure) are required.

The second example, RC=100, illustrates how it is possible to route towards an announcement. By using program one (P01) with three lines (P01=1, P01=2 and P01=3) it is possible to specify routing alternatives in the case of one or more routes being congested or unobtainable.

The final example (RC=60) shows the definition of a routing case used to point towards the gateway functionality (GRI route). Here, as there are no alternative routes or branching conditions, a procedure is not required and so only one line of data using the ANRSI command is needed. Also note that as the GRI route is a software route, that is, non-circuit related, a compatibility check is not requested (CCH=NO).

Figure 9-20 shows an example of routing alternatives using another branching parameter Route Origin (RO) for route selection. The example relates to Exchange A.




```
EXROI:R=MSC_BO&MSC_BI, DETY=UPD,  FNC=3, SI=ISUP4, SP=2-300;
EXRBC:R=MSC_BI, BO=30,  RO=1,  TDCL=15;

ANRPI: RC=1;
ANRSI: BR=RO-0,     P01=1, R= MSC_CO, SP= MM1;
ANRSI:              P01=2, R= MSC_DO, SP= MM1;
ANRSI:              P01=3, R= MSC_BO, SP= MM1;

ANRSI: BR=RO-1,     P02=1, R= MSC_CO, SP= MM1;
ANRSI:              P02=2, R= MSC_DO, SP= MM1;
ANRPE;
```

Figure 9-23: Example of Routing Alternatives

The RO parameter is defined on a per cell basis and is changed by the MGCEC command or as in the example defined on an incoming route.

The example shows a call being routed between Exchange A and Exchange C. If a call originates in Exchange A, then RO=0, and the call will have a direct path to Exchange C or two alternatives (via D or B). However, if the call comes from Exchange B via route MSC_BI, then RO=1. As a result there is a direct connection and one alternative via Exchange D. This is because there is no point sending it via Exchange B, since the call has just arrived from there.

ROUTE DATA

The route data has already been defined in module 4. The EXROI and EXRBC commands were used to define the route data.

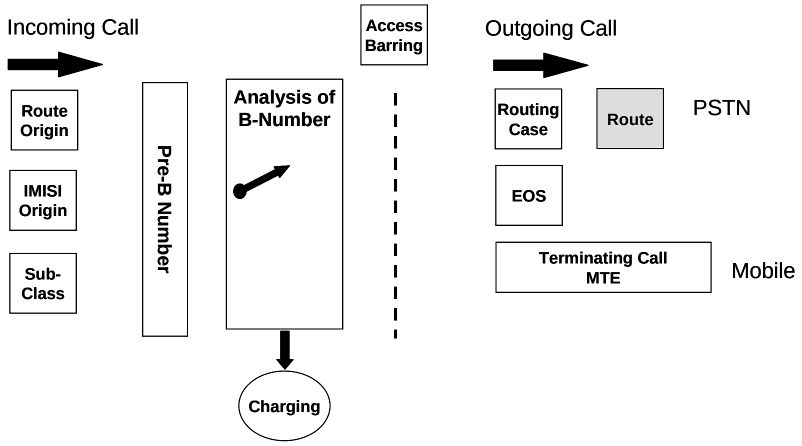


Figure 9-24: Route Data

A-NUMBER ANALYSIS

The main purpose of the A-number analysis is to determine the parameter value of ACO (A-number Charge Origin). A different value for this parameter can be given for each operator roaming in the network. The ACO is then used as a branch parameter in the Charging Analysis.

The A-number analysis, like the B-number analysis, is split into two parts: pre-analysis and then analysis of the A-number. The A-number can only be internationally or nationally significant, namely: ANT=1 or ANT=4. The A-number is usually stored in the international format, ANT=1. However, if the parameter NATMS (National MS) has been defined in the IMSI number series analysis (the MGISI command), the A-number will be nationally significant, ANT=4.

The A-number analysis is required for the call to be set up. If an A-number series is missed, **the call will fail**.

The commands used for the A-number analysis are:

- PNASI for the pre-analysis
- ANASI for the analysis of the A-number

```
!** ANALYSIS OF INTERNATIONAL A-NUMBER **!
ANAZI;
ANASI:A=0-0, STATUS=ZERO;
ANASI:A=0-1, ACO=1;
ANASI:A=0-43,ACO=1;
ANASI:A=0-44,ACO=2; ! UK SUBSCRIBER !
ANASI:A=0-45,ACO=1;
ANASI:A=0-46,ACO=0; ! SWEDISH SUBSCRIBER !
ANASI:A=0-47,ACO=1;
ANASI:A=0-48,ACO=1;
ANASI:A=0-49,ACO=3; ! GERMAN SUBSRIBER !
ANASI:A=0-5, ACO=1;
!**** ANALYSIS OF NATIONAL A-NUMBER ****!
ANASI: :A=1-0, ACO=0;
ANASI: :A=1-1, ACO=0;
ANASI: :A=1-2, ACO=0;
ANASI: :A=1-3, ACO=0;
ANASI: :A=1-4, ACO=0;
ANASI: :A=1-5, ACO=0;
ANASI: :A=1-6, ACO=0;
ANASI: :A=1-7, ACO=0;
ANASI: :A=1-8, ACO=0;
ANASI: :A=1-9, ACO=0;
ANAAI;
!**** PRE A-NUMBER ANALYSIS ****!
PNAZI;
PNASI:NAPI=1,ANT=1,OAA=0,STATUS=ZERO; ! INT. !
PNASI:NAPI=1,ANT=4,OAA=1; ! NAT. !
PNAAI;
```

Figure 9-25: A-Number Analysis

CHARGING ANALYSIS

The Charging analysis is only mentioned here to give a fuller picture of the mobile originated call, but it will be treated in more detail in Chapter 12.

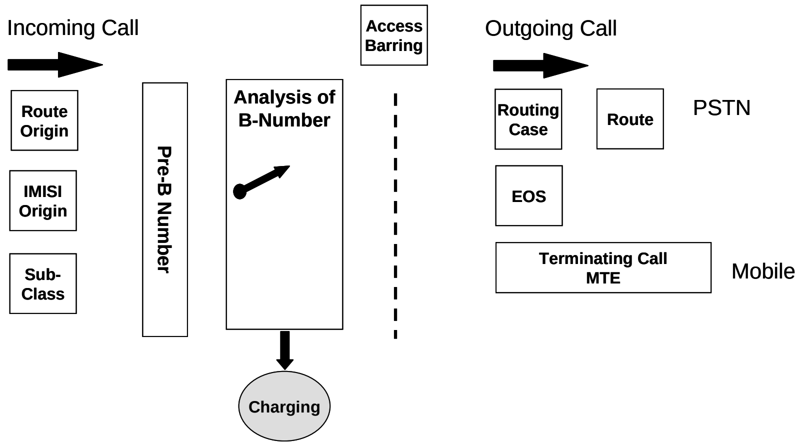


Figure 9-26: Charging Analysis

It is possible to charge for different parts of the call, namely:

1 The mobile originating leg (MO TT record)

2 The roaming call forward leg (RCF TT record)

3 The mobile terminating leg (MT TT record)

Figure 9-24 and Figure 9-25 show these three different cases.

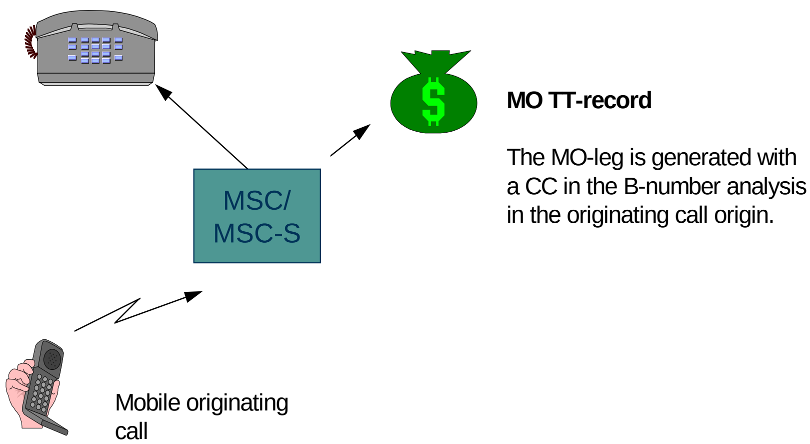


Figure 9-27: Mobile Originating Leg

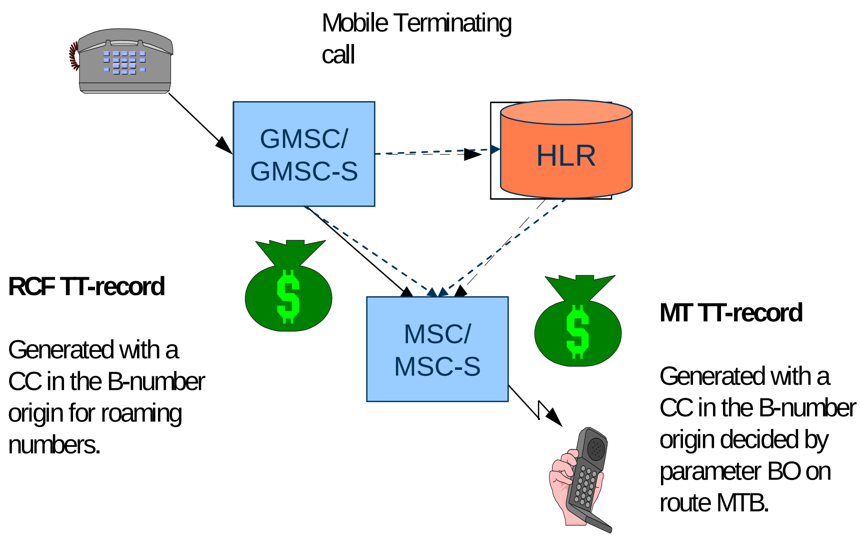


Figure 9-28: Roaming Call Forward and Mobile Terminating Legs

To generate the Toll Ticketing record a Charging Case (CC) needs to be generated from within the B-number analysis. The CC would be sent to charging analysis to generate the TT record and then store a whole range of information in the record.

Figure 9-26 shows what happens to the CC. The charging analysis is now split into two parts, an initial charging analysis based on the type of call and then to charging analysis to generate the Tariff Class (TC). The tariff class is only needed if the supplementary service Advice of Charge is being used.

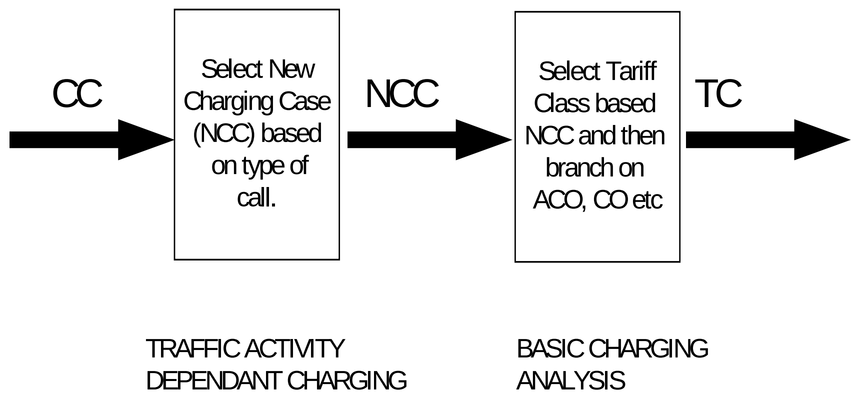


Figure 9-29: Process for Charging Case Analysis

It can be seen that a CC has been generated from the B-number analysis, which is then analyzed and will generate a new charging case (NCC) based on the type of call. For example a telephone call and a data call could generate new but different charging cases. The new charging case is then analyzed and branching can then take place depending on the ACO generated from the A-number analysis.

END OF SELECTION ANALYSIS

The End Of Selection (EOS) is used to leave software routines in a controlled manner, if something unexpected happens. For example EOS might be used to start an announcement routine or to generate a busy tone, for example.

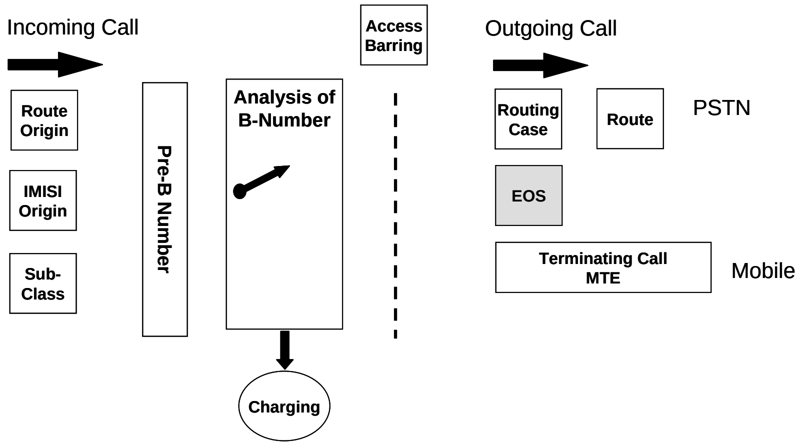


Figure 9-30: End Of Selection Analysis

Different user blocks will generate an end of selection code, which is transferred to the RE (register) function block and then to RA (route analysis) to find the course of action required for a particular EOS code. The EOS codes and their explanation are found in the Application Information for the function blocks concerned. The recommended action will also be specified 28 highlight this.

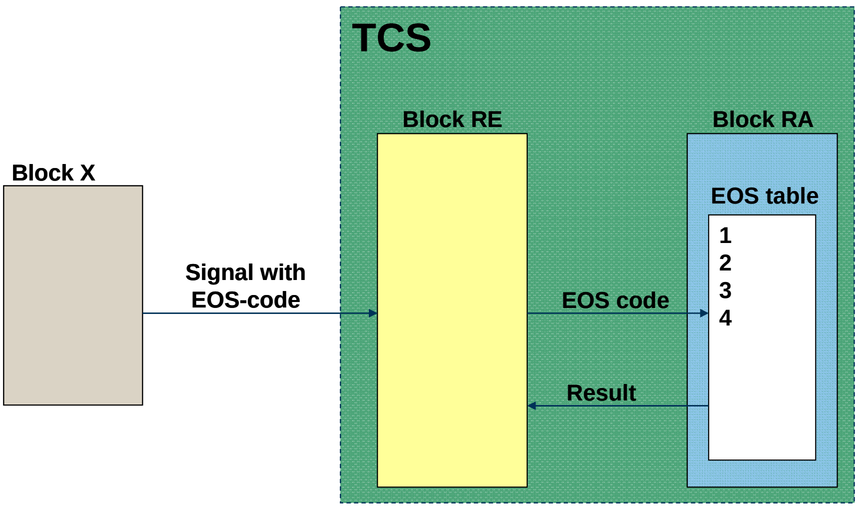


Figure 9-31: Example of End of Selection Analysis

EMERGENCY CALL

Mobile Subscriber emergency calls are handled as highest priority calls. The emergency call number is 112 (911 for ANSI). When this number is dialed, the Connection Management (CM) Service request message from the MS indicates that this is an emergency call establishment. (See Figure 9-29)

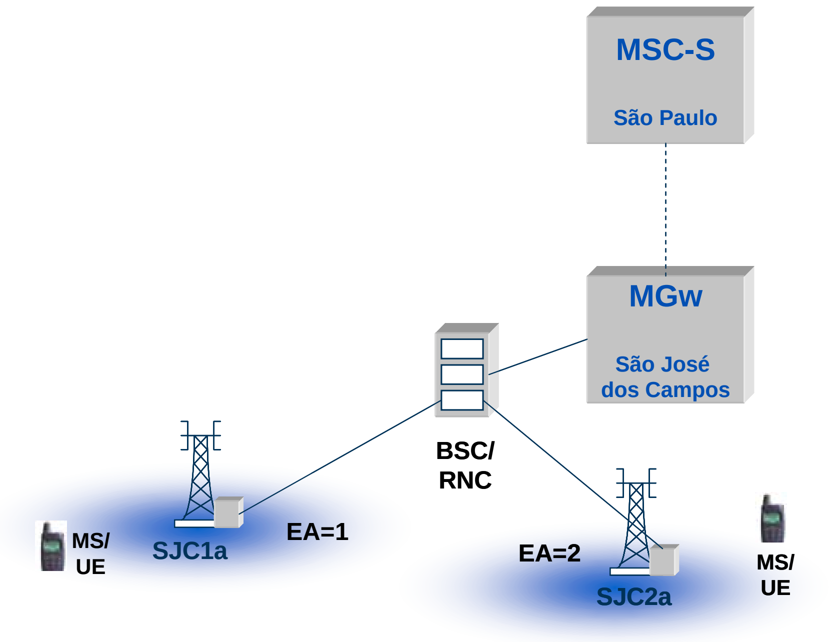


Figure 9-32: Emergency call

The emergency call is set up in a manner that is similar to the basic traffic case “call from UE” with the exception that some functions are invoked/ignored depending on the setting of certain emergency call related exchange parameters (these properties are set with the MGEPC command).

- EMCNOIMSI-determines whether an emergency call is allowed without a SIM-card.
- EMCNOLU-determines if an emergency call can be carried out when location updating has not been made, when a SIM-card is installed in the MS.
- IMEICONTROLEMR-determines if the IMEI check is to be performed for a mobile originated emergency call.
- IMEIROUTGRYEMR-determines if an emergency call is to be rerouted to an announcement or operator in case the MS is not type-approved (gray listed).

After receiving a request from the UE to set up the call, a telecommunication service analysis is performed for the emergency call, and an End of Selection (ES) code is generated:

- 2290 if the call is to be set up with a SIM-card
- 2577 if no SIM-card is installed in the MS.

This ES code is converted into a B-number, which is then analyzed in the ordinary B-number table. The output from this analysis is a Routing Case (RC).

The Emergency call routing is determined by the RC, RO (Routing Origin) and EA (Emergency Area) parameters. The RO and EA category is specified on a per cell basis.

Example:

- **For GSM:**

```
<MGCEP:CELL=ALL;
MT CELL DATA
CELL     CGI            BSC       CO    RO    NCS   EA
SJC1a    724-02-60-4    BSJC1     4     1     0     1
SJC2a    724-02-61-5    BSJC1     4     1     0     2
END
```

- **For WCDMA:**

```
<MGAAP:AREA=ALL;
MT AREA CLUSTER DATA

AREA     ACET           AREAID          RO    CO    EA
SJC1a    SAI            724-02-60-4     0     0     0
SJC2a    SAI            724-02-60-4     0     0     0
END
```

Figure 9-33: Printout of Cell/Area data

ENHANCED EMERGENCY CALL ROUTING

This feature enables the MSC/VLR to provide access in a more flexible way to an increased number of emergency call centers. The feature is applicable to all mobile originating calls and thus not only to emergency calls (112). (See Figure 9-31).

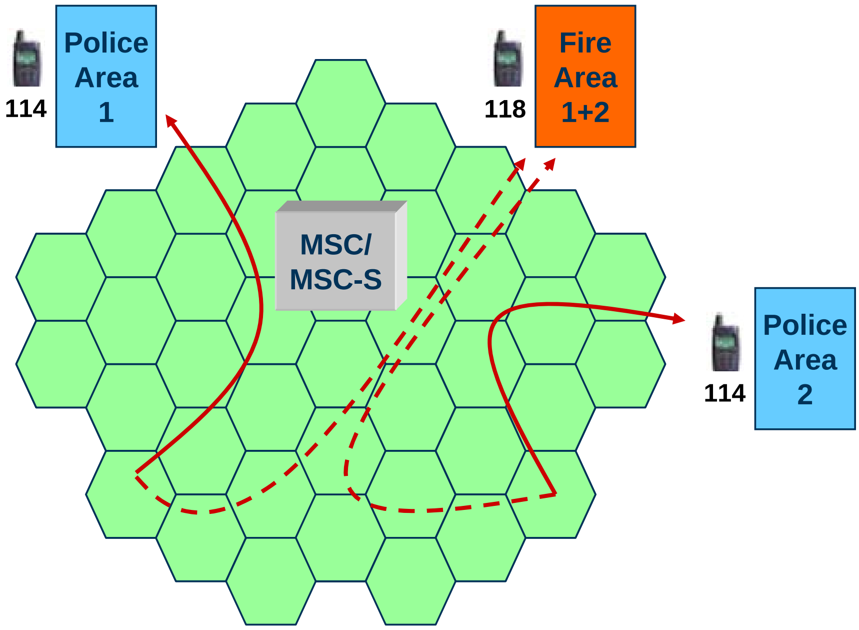


Figure 9-34: Emergency Call Routing

Up to 65535 emergency centers with a fixed "normal" telephone rerouting number can be defined in an MSC. Up to 16 of these emergency centers can be connected to a specific geographical area (a cell or a Location Area LA, or the whole MSC, or the neighboring MSC area). This is defined with the name of the emergency center and an index number between 1 and 16.

For emergency calls a normal B-No. Analysis is used to convert an emergency number into a rerouting number. In the B-No. analysis calling, an emergency short number like 110, 112, 114, 90000 will result in a SII parameter (Signal Information to Incoming side). This parameter is a pointer to the index number.

With this index number and the originating geographical information the rerouting number is determined.

A schematic flow through the different analysis tables is illustrated in Figure 9-32. For more information, read the Adaptation Direction of the MERNA block.

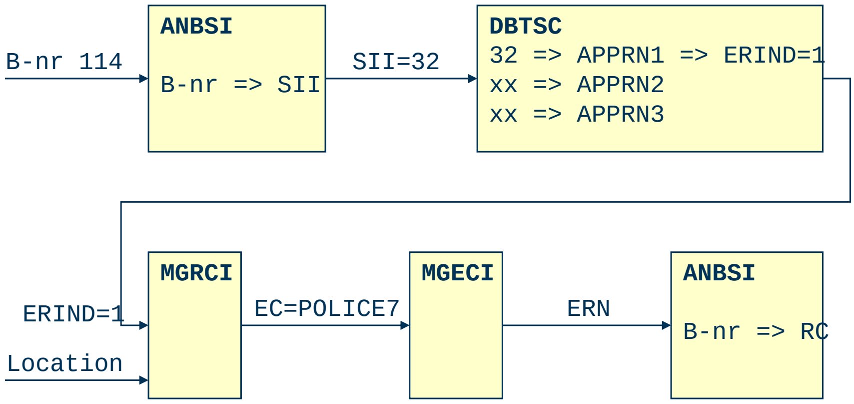


Figure 9-35: Analysis Tables of an Emergency Call Schematic Flow

DATA TRANSCRIPT FOR ENHANCED EMERGENCY CALL ROUTING

- **Connect Emergency Center to Index (ERIND):**
  MGRCI:CELL=SPAULO1,EC=POLICE7,ERIND=1; !For GSM!
  MGRCI:AREA=SPAULO1,EC=POLICE7,ERIND=1; !For WCDMA!
- **Define Emergency Center number:**
  MGECI:EC=POLICE7,ERN=41313301122;
- **Activate the Enhanced Emergency option:**
  DBTRI;
  DBTSC:TAB=AXEPARS, SETNAME=GSM1APTC, NAME=APPERNUSE, VALUE=1;
- **Set ERIND value:**
  DBTSC:TAB=AXEPARS, SETNAME=GSM1APTC, NAME=APPERN1, VALUE=32;
  DBTRE:COM;
- **Add Emergency Call in the B-number analysis table:**
  ANBSI:B=0-114,SII=32,F=1,RC=300,L=3-23; !Default RC!
  ANBSI:B=1-41313301122,RC=73;

Figure 9-36. Enhanced Emergency Call Routing DT Example

If a subscriber calls an emergency number (for example, 114 to the police), the AXE parameter APPERNUSE switches the emergency routing on (value 1). In the B-Number analysis the emergency number (114) results in an SII value (32). This SII value is transferred into the ERIND value 1 by the AXE parameters (the AXE parameter APPERN1 has the VALUE 32). Therefore SII32 results in ERIND, equal to 1 to analyze the MGRCI table. With the ERIND value and the geographical information on the originating call party, the B-number is changed to 41313301122 according to the ERN value, and the B-number analysis is continued in a new B-origin and results in an RC 73.

DATA TRANSCRIPT

Figure 9-34 shows a schematic of the analysis flow used for routing mobile originated calls. End of Selection Analysis can take place in any part of this flow, generated by specific blocks, or as shown in the diagram can be specified using an ES code by command.

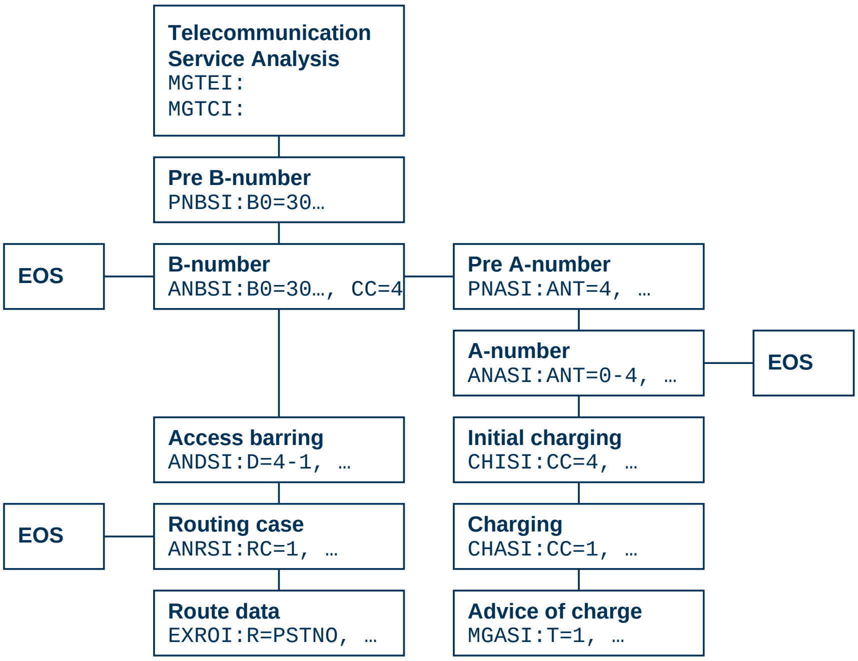


Figure 9-37: Selection of MML Commands for Analysis of a Mobile Originated Call

Note: The A-Number analysis has not been included, as the same data would apply to each case. See the example shown in Figure 9-34.

TELEPHONY CALL

```
!16000,1!
!**** TELECOMMUNICATION SERVICE ANALYSIS ****!
MGTEI:TEC=THY, TSC=1, CRT=FR-FR, PSCVL=FRV1&FRV2;
MGTEI:TEC=THY, TSC=1, CRT=DHR-DHRC, PSCVL=FRV1&FRV2&HRV1;
MGTEI:TEC=THY, TSC=1, CRT=DFR-DFRC, PSCVL=FRV1&FRV2&HRV1;
MGTCI:TSC=1, WSIG=NOIS, TBP=NO, TPI=YES, NOTE="THY";

!76000,1!
!**** IMSI NUMBER SERIES ANALYSIS ****!
MGISI:IMSIS=415 01,M=5-961 32,NA=4,ANRES=OBA-30&CBA-63&
   PLMN-0&NATMS&...;

!15700,1!
!**** PRE B-NUMBER ANALYSIS ****!
PNBSI:BO=30, NAPI=1, BNT=1, OBA=22;
PNBSI:BO=30, NAPI=1, BNT=2, OBA=30;
```

Figure 9-38: Mobile Originated - Telephony Call (1) ALL MSC Blades

```
!15600,1!
!**** B-NUMBER ANALYSIS DATA ****!
ANBSI:B=30-03, L=8;
ANBSI:B=30-036, RC=15, CC=3, L=8, D=4-1;

!15400,1!
!**** ROUTING CASE ANALYSIS ****!
ANRSI:RC=15, R=INTR1O, SP=MM1; !To TSC Blade!

!15300,1!
!**** ROUTE DATA ****!
EXROI:R=INTRT1O,DETY=INTRO,FNC=1;
EXRBC:R=INTRT1O,RGPAR=DIS-2&BLAO-4;

!15500,1!
!**** ACCESS BARRING ANALYSIS ****!
ANDSI:D=4-1, TDCL=1;
```

Figure 9-39: Mobile Originated - Telephony Call (2) ALL MSC Blades

When there is a call to another PLMN or PSTN, it goes to the TSC Blades as they have the BICC and ISUP routes to these destinations.

The RC=15 has the INTRO route to TSC Blade. The parameter RGPAR in the EXRBC command, DIS-2 represents 'TSC distribution is specified' and BLAO-4, blade origin. FNC=1 is an outgoing route.

On TSC Blades there should be also an INTRO route related to this BLAO-4, i.e. this parameter means the relationship between outgoing and incoming traffic data from MSCs and TSCs Blades.

```
!15600,1!
!**** B-NUMBER ANALYSIS DATA ****!
ANBSI:B=30-03, L=8;
ANBSI:B=30-036, RC=6, CC=3, L=8, D=4-1;

!15400,1!
!**** ROUTING CASE ANALYSIS ****!
ANRSI:RC=6, R=PLMNO, SP=MM1; !TO PLMN!

!15300,1!
!**** ROUTE DATA ****!
EXROI:R=PLMNO&PLMNI, DETY=BID, FNC=3, SP=2-15660;
EXRBC:R=PLMNI, BO=1, CO=31;
!**** INCOMING ROUTE FROM MSC/TSC BLADE ****!
EXROI:R=INTRB1I,DETY=INTRO,FNC=2;
EXRBC:R=INTRB1I,RGPAR=BLAO-4;

!15500,1!
!**** ACCESS BARRING ANALYSIS ****!
ANDSI:D=4-1, TDCL=1;
```

Figure 9-40: Mobile Originated - Telephony Call (3) TSC Blades

INTRO routes act as an internal trunk for interconnecting the blades within the cluster. In the TSC blade, the INTRO route definition is done by the command EXROI with FNC=2, incoming route. The BLAO-4 means that this is receiving traffic data from a blade origin 4.

The same pre- and b-number analysis is done in the TSC blade in the same origin as no modification is set in the INTRO routes.

The result of this analysis is another routing case, now RC=6 which is routing to the PLMN using the R=PLMNO.

EMERGENCY CALL

```
!**** TELECOMMUNICATION SERVICE ANALYSIS ****!
!GSM!
MGTEI:TEC=EMERG, TSC=99, CRT=FR-FR, PSCVL=FRV1&FRV2;
MGTCI:TSC=99, WSIG=NOIS, TBP=NO, TPI=YES, NOTE="EMERG";
!WCDMA!
MGTEI:TEC=EMERG,  TSC=99    ,UMTS;


!**** END OF SELECTION ANALYSIS ****!
ANESI:ES=2290, F=30, M=0-112;
ANESI:ES=2577, F=30, M=0-112;

!**** PRE B-NUMBER ANALYSIS ****!
PNBSI:BO=30, NAPI=1, BNT=1, OBA=22;
PNBSI:BO=30, NAPI=1, BNT=2, OBA=30;
```

Figure 9-41: Mobile Originated - Emergency Call (1)

```
!**** B-NUMBER ANALYSIS DATA ****!
ANBSI:B=30-112, L=3, RC=15, BNT=2; !MSC Blades!

!**** B-NUMBER ANALYSIS DATA ****!
ANBSI:B=30-112, L=3, RC=2, BNT=2;

!**** ROUTING CASE ANALYSIS ****!
ANRPI:RC=2;
ANRSI:BR=TMR-0&-3&-4,R=PSTN1O,SP=MM1,ESS=0,ESR=1, P01=1;
!EC REQUIRED!
ANRSI:BR=TMR-1&-2,R=PSTN1O,SP=MM1,ESS=0,ESR=0,P01=2;
!EC NOT REQUIRED!

!**** ROUTE DATA ****!
EXROI:R=PSTN1O&PSTN1I, DETY=UPDR, FNC=3, SI=ISUP4,
   SP=2-13555;
```

Figure 9-42: Mobile Originated - Emergency Call (2)

Notice again that the DT in case of MSC Blade, it should be route to TSC Blade via INTRO route (RC=15) then the TSC Blade routes it to the PSTN.

FAX CALL

```
!**** TELECOMMUNICATION SERVICE ANALYSIS ****!
MGTEI:TEC=AFX3,TSC=5,TRI=T,ACC=”14.4”;
MGTCI:TSC=5,WSIG=ISPR,TBP=YES,TPI=NO,NOTE=“AFX3”,TCL=6;

!**** IMSI NUMBER SERIES ANALYSIS ****!
MGISI:IMSIS=415 01,M=5-961 32,NA=4,ANRES=OBA-30&CBA-63&
PLMN-0&NATMS&…..;

!**** PRE B-NUMBER ANALYSIS ****!
PNBSI:BO=30, NAPI=1, BNT=1, OBA=22;
PNBSI:BO=30, NAPI=1, BNT=2, OBA=30;
```

Figure 9-43: Mobile Originated – Fax Call (1) For GSM Only

```
!**** B-NUMBER ANALYSIS DATA ****!
ANBSI:B=30-03, L=8;
ANBSI:B=30-036, RC=15, CC=3, L=8, D=4-1;

!**** B-NUMBER ANALYSIS DATA ****!
ANBSI:B=30-03, L=8;
ANBSI:B=30-036, RC=6, CC=3, L=8, D=4-1;

!**** ROUTING CASE ANALYSIS ****!
ANRSI:RC=6, R=PLMNO, SP=MM1; ! TO PLMN !

!**** ROUTE DATA ****!
EXROI:R=PLMNO&PLMNI,DETY=UPDR,FNC=3,SI=ISUP4,SP=2-15660;
EXRBC:R=PLMNI, BO=1, CO=31;
EXROI:R=GIWU1O&GIWU1I,DETY=MIWULT,FNC=3,DPC=999;
EXROI:R=GIWU2O&GIWU2I,DETY=MIWULT,FNC=3,SI=ISUP,DPC=999;
EXROI:R=DTI1,DETY=MIWUD;

!**** ACCESS BARRING ANALYSIS ****!
ANDSI:D=4-1, TDCL=1;
```

Figure 9-44: Mobile Originated – Fax Call (2) For GSM Only

Intentionally Blank

10 Mobile Terminating Call

Objectives

Define exchange data for a mobile terminating call from a PSTN/PLMN to a GSM/WCDMA mobile subscriber.

- Develop the exchange data used for routing mobile originating calls and explain the major parameters.
- Write MML supporting a call to an MS/UE by interpreting the exchange requirements.

Figure 10-1. Objectives

Intentionally Blank

INTRODUCTION

This module follows the analysis required to set up a call, from the received digits in the GMSC to the paging of the MS. For completeness the main data required in the HLR is also considered.

CALL TO A MS/UE

In the given example, the MGW nodes are not the main focus here as they were described in previous courses as well.

In the figure below shows the call flow in high level. Detailed traffic case inside MSC-S BC is described later on in the Data Transcript session.

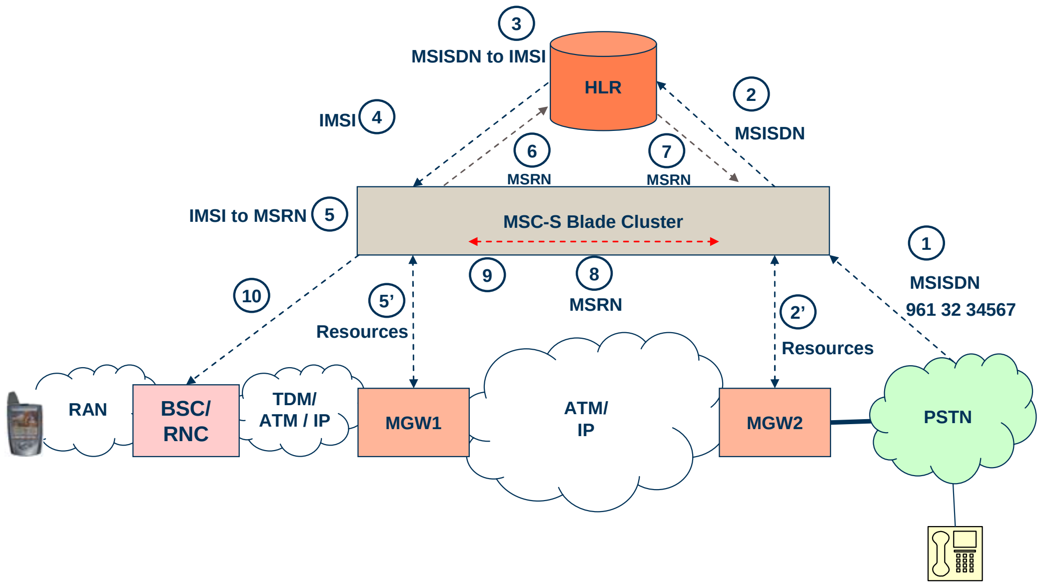


Figure 10-2: Call to MS/UE

The call to the MS/UE is the most involved traffic case to consider. It involves both circuit related signaling and non-circuit related signaling.

It is also important to remember that the GMSC as a function is only used for calls to an MS/UE. In other words we have an MSC with Gateway functionality. The Gateway functionality is only required in order to communicate with the HLR.

Using the previous figure as the basis, the following description shows how a call is routed to an MS.

12 A call is routed based on the MSISDN to an MSC-S BC (internally, first pass to SPX then TSC and then to MSC Blade) with Gateway functionality belonging to the HPLMN of the subscriber. This might be routed through another network or could be initiated in the same exchange (if the call originated from another MS). The MSC analyzes the MSISDN and determines that before the call can be routed, some addressing information from the HLR is required. The only node that can interrogate the HLR for information is the Gateway MSC. Therefore the call is passed to the Gateway functionality (inside MSC Blades).

13 The Gateway sends a MAP message, Send Routing Information (SRI) or Routing Information Request (RIR), to the HLR asking for routing information for the MS/UE. The MSISDN is transferred in the international format with the MAP message.

14 The HLR checks the subscription of the MS/UE based on the MSISDN and also obtains the IMSI, which will be used in the GSM network.

15 The HLR sends a MAP message, Provide Roaming Number (PRN), to the MSC/VLR where the MS/UE is currently located (this could be in the HPLMN of the MS/UE or it could be a different PLMN if the MS/UE is roaming). The IMSI will be transferred with the MAP message.

16 The VLR checks whether the MS/UE is attached or not. If the MS/UE is attached, the MSC/VLR will allocate a Mobile Station Roaming Number (MSRN) and link it to the IMSI.

17 The MSC/VLR will send the MSRN back to the HLR using the MAP message, PRN Acknowledge.

18 The HLR returns the MSRN to the Gateway using the MAP message SRI Acknowledgement. The Gateway then passes the return MSRN to the MSC for further analysis.

19 The MSC will analyze the MSRN and then determine how to route the call to the MSC where the MS/UE is currently located.

In the above example the MS/UE is located in the same MSC/VLR as the call was routed to. In another situation, if the MS/UE is located in a different MSC/VLR, the call would need to be routed over the network, using own PLMN, PSTN and International switches where necessary, using ISUP to set up the call.

20 On reception of the ISUP/BICC signal carrying the MSRN, the MSC will analyze the number and determine that the MSRN belongs to this switch and that the signaling requests the switch to set up a call to an MS/UE.

21 The MS will now be paged in all cells belonging to the LAI in which the MS/UE is currently situated.

Note: The RNC is could be connected via ATM or IP to MGW and the BSC is connected via TDM only. The signaling and when the MGW selections are not discussed here.

DATA TRANSCRIPT

The following descriptions will consider the data transcript required in each of the above nodes and will be based on the description shown in previous figure.

It is important to consider the various B-numbers that can be presented to MSC-S BC. From the network plan (for our first example network) we need to consider that the number could be directed to a BL device, that is, a test call. The number could be an MSISDN and it can also be an MSRN for a call to a mobile in MSC-S BC.

All of these numbers are in the range 961 3 200000 to 961 3 599999.

ANALYSIS OF MSISDN IN MSC-S BC

The MSISDN can be received from one of two places; either an MS/UE connected to an MSC/VLR in the same PLMN or routed from another network, for example, the PSTN or another PLMN.

If the call originates from within this same MSC, the chosen B-origin will be determined by the **OBA parameter in the IMSI number series analysis** for the originating MS. In our network plan, all MO calls are analyzed in B-origin 30.

If the call originated from another network, the B-origin to analyze the MSISDN will be chosen by the **BO parameter on the incoming route**; in our network plan all incoming calls will be analyzed in B-origin 0.

B-number Analysis

Remember that the B-number analysis is carried out in two stages: the pre-analysis and then the analysis of the B-number.

If the calls originated from within our own PLMN, the number dialed can be of the unknown type (BNT=2), but may also be of the international type (BNT=1).

If the call originated from outside our own PLMN, the number could be presented in several ways, depending on where it originated.

If the call came via the PLMN or the PSTN1, both supporting ISUP, the number would be presented in the national (BNT=4) or maybe in the unknown (BNT=2) format. It could also be presented in the international format (BNT=1). Agreements between network operators are needed.

Figure below shows an example of how to define DT needed for supporting a call to an MS.

Note: Origin 22 would also need to be defined; this origin will contain all international format numbers received from mobiles.

```
!15700,1!
!**** PRE-ANALYSIS ****!
PNBSI:BO=0, NAPI=1, BNT=1, OBA=1;
PNBSI:BO=0, NAPI=1, BNT=2, OBA=0;
PNBSI:BO=0, NAPI=1, BNT=4, OBA=1;

PNBSI:BO=30, NAPI=1, BNT=1, OBA=22;
PNBSI:BO=30, NAPI=1, BNT=2, OBA=30;
PNBSI:BO=30, NAPI=1, BNT=4, OBA=30;

!15600,1!
!**** ANALYSIS OF B-NUMBER ****!
ANBSI:B=0-03;
ANBSI:B=0-032, RC=3303, L=8, M=1-961, D=1-0, CW, NW, BNT=1;
ANBSI:B=0-033, RC=3303, L=8, M=1-961, D=1-0, CW, NW, BNT=1;
:
```

Figure 10-3: DT to route call from TSC to MSC Blade

```
!cont.!
ANBSI:B=1-32, RC=3303, L=7, M=0-961, D=1-0, CW, NW, BNT=1;
ANBSI:B=1-33, RC=3303, L=7, M=0-961, D=1-0, CW, NW, BNT=1;

ANBSI:B=1-961 32, RC=3303, L=10, D=1-0, CW, NW, BNT=1;
ANBSI:B=1-961 33, RC=3303, L=10, D=1-0, CW, NW, BNT=1;

ANBSI:B=30-03, L=8;
ANBSI:B=30-032, RC=3303, CC=1, M=1-961, L=8, D=1-0, BNT=1;
ANBSI:B=30-033, RC=3303, CC=1, M=1-961, L=8, D=1-0, BNT=1;

!15400,1!
!**** ROUTING CASE ANALYSIS ****!
ANRSI:RC=3303,R=INTRB1O,SP=MM1,CCH=NO;
```

Figure 10-4: DT to route call from TSC to MSC Blade

It can be seen that the pre-analysis directs the analysis of the incoming MSISDN to the correct B-origin in the B-number analysis table.

The important thing to note from the B-number analysis table is that the MSISDN is changed to the international format by modifying the number and then setting the BNT=1. This is very important as the MSISDN is used as a Global Title address for SCCP purposes.

The CW parameter (A-Class Wanted) and the NW parameter (A-number Wanted) are specified as parameters available from the Application Information for GRI.

Routing Case 3303 has been chosen for the analysis to transfer it to the MSC Blade. The b-number is transferred from TSC to a MSC Blade via INTRO Route. The MSC Blades are responsible to query the HLR node by using GRI route.

The figure below shows only part of the number series required for routing the MSISDN from TSC Blades to the MSC Blades so that they can query the HLR. The number series beginning with 961 3 4xxxxx are used for several different types of numbers: MSISDNs, MSRNs and BLs. This means that the analysis of the number series needs to be taken further. Figure below shows this only for B-origin 0. B-origins 1 and 30 would need to be considered in a similar way.

```
!15600,1!
!**** ANALYSIS OF B-NUMBER ****!
ANBSI: B=0-034000, RC=25, L=8, M=1, BNT=4;   !MSRN TO MSC1!
ANBSI: B=0-034001, RC=25, L=8, M=1, BNT=4;   !MSRN TO MSC1!
ANBSI: B=0-034002, F=9, L=8, M=1, BNT=4;     !MSRN TO OWN MSC!
ANBSI: B=0-034003, F=9, L=8, M=1, BNT=4;     !MSRN TO OWN MSC!
ANBSI: B=0-034004, RC=26, L=8, M=1, BNT=4;   !MSRN TO MSC2!
ANBSI: B=0-034005, RC=26, L=8, M=1, BNT=4;   !MSRN TO MSC2!

ANBSI: B=0-03401, RC=3303, L=8, M=1-961, D=1-0, CW, NW, BNT=1;
ANBSI: B=0-03402, RC=3303, L=8, M=1-961, D=1-0, CW, NW, BNT=1;
               :
ANBSI: B=0-03409, RC=3303, L=8, M=1-961, D=1-0, CW, NW, BNT=1;

ANBSI: B=0-0341, RC=3303, L=8, M=1-961, D=1-0, CW, NW, BNT=1;
ANBSI: B=0-0342, RC=3303, L=8, M=1-961, D=1-0, CW, NW, BNT=1;
              :
ANBSI: B=0-0349, RC=3303, L=8, M=1-961, D=1-0, CW, NW, BNT=1;
```

Figure 10-5: Further B-number Analysis

Due to a number series being split between several users, care and consideration must be given to this situation when setting up the B-number analysis table.

When the TSC Blades send the call setup to the MSC Blades it will be analyzed again in the B-number table in the same entry point i.e. in the same b-number origin. But now, the Routing Case should be the route to HLR.

```
!15700,1!
!**** PRE-ANALYSIS ****!
PNBSI:BO=0, NAPI=1, BNT=1, OBA=1;
PNBSI:BO=0, NAPI=1, BNT=2, OBA=0;
PNBSI:BO=0, NAPI=1, BNT=4, OBA=1;

PNBSI:BO=30, NAPI=1, BNT=1, OBA=22;
PNBSI:BO=30, NAPI=1, BNT=2, OBA=30;
PNBSI:BO=30, NAPI=1, BNT=4, OBA=30;

!15600,1!
!**** ANALYSIS OF B-NUMBER ****!
ANBSI:B=0-03;
ANBSI:B=0-032, RC=60, L=8, M=1-961, D=1-0, CW, NW, BNT=1;
ANBSI::B=0-033, RC=60, L=8, M=1-961, D=1-0, CW, NW, BNT=1;
...
```

Figure 10-6: Route a Call to GRI

```
!cont.!
ANBSI:B=1-32, RC=60, L=7, M=0-961, D=1-0, CW, NW, BNT=1;
ANBSI:B=1-33, RC=60, L=7, M=0-961, D=1-0, CW, NW, BNT=1;

ANBSI:B=1-961 32, RC=60, L=10, D=1-0, CW, NW, BNT=1;
ANBSI:B=1-961 33, RC=60, L=10, D=1-0, CW, NW, BNT=1;

ANBSI:B=30-03, L=8;
ANBSI:B=30-032, RC=60, CC=1, M=1-961, L=8, D=1-0, BNT=1;
ANBSI:B=30-033, RC=60, CC=1, M=1-961, L=8, D=1-0, BNT=1;

!15400,1!
!**** ROUTING CASE ANALYSIS ****!
ANRSI:RC=60, R=0GRI3, SP=MM1, CCH=NO;
ANRSI:RC=3301,R=INTRT1O,SP=MM1,CCH=NO, ESR=0, ESS=1;
```

Figure 10-7: Route a Call to GRI (cont.)

Note that the INTRO routes defined in the MSC Blades are used to route calls to TSC Blades and the TSCs route to external networks via ISUP/BICC routes.

```
!15600,1!
!**** ANALYSIS OF B-NUMBER ****!
ANBSI: B=0-034000, RC=25, L=8, M=1, BNT=4;   !MSRN TO MSC2!
ANBSI: B=0-034001, RC=25, L=8, M=1, BNT=4;   !MSRN TO MSC2!
ANBSI: B=0-034002, F=9, L=8, M=1, BNT=4;     !MSRN TO OWN MSC!
ANBSI: B=0-034003, F=9, L=8, M=1, BNT=4;     !MSRN TO OWN MSC!
ANBSI: B=0-034004, F=9, L=8, M=1, BNT=4;     !MSRN TO OWN MSC!
ANBSI: B=0-034005, F=9, L=8, M=1, BNT=4;     !MSRN TO OWN MSC!
ANBSI: B=0-034006, RC=26, L=8, M=1, BNT=4;   !MSRN TO MSC3!
ANBSI: B=0-034007, RC=26, L=8, M=1, BNT=4;   !MSRN TO MSC3!

ANBSI: B=0-03401, RC=60, L=8, M=1-961, D=1-0, CW, NW, BNT=1;
ANBSI: B=0-03402, RC=60, L=8, M=1-961, D=1-0, CW, NW, BNT=1;
                :
ANBSI: B=0-03409, RC=60, L=8, M=1-961, D=1-0, CW, NW, BNT=1;
ANBSI: B=0-0341, RC=60, L=8, M=1-961, D=1-0, CW, NW, BNT=1;
ANBSI: B=0-0342, RC=60, L=8, M=1-961, D=1-0, CW, NW, BNT=1;
               :
ANBSI: B=0-0349, RC=60, L=8, M=1-961, D=1-0, CW, NW, BNT=1;
```

Figure 10-8: Further B-number Analysis - All MSC Blades

Routing Case Analysis

A Routing Case is chosen to direct the call to a route. In this case the route is to select an individual in GRI to carryout the interrogation of the HLR.

In case the call received is from another PLMN or PSTN networks, they possibly connected via BICC or ISUP routes. So the first blade to analyze the B-numbers received is the TSC. TSC Blades need to route this call setup to MSC Blades due to the MSC Blades are the only one that can fetch the subscriber location information by querying the HLR via GRI routes.

Next figure shows the Routing Case Analysis data transcript required for supporting the selection of the route. From the Application Information for the INTRO block the values of the FNC, BLAO and DIS parameters can be obtained. The purpose of BLAO is an index to correlate the incoming and outgoing routes.


```
!***INCOMING ROUTE FROM MSC/TSC BLADE***!
EXROI:R=INTRB1I,DETY=INTRO,FNC=2;
EXRBC:R=INTRB1I,RGPAR=BLAO-4;
BLORE:R=INTRB1I;
EXROI:R=INTRT1I,DETY=INTRO,FNC=2;
EXRBC:R=INTRT1I,RGPAR=BLAO-5,RG=10;
BLORE:R=INTRT1I;


!***OUTGOING ROUTE TOWARDS MSC BLADE**!
EXROI:R=INTRB1O,DETY=INTRO,FNC=1;
EXRBC:R=INTRB1O,RGPAR=DIS-3&BLAO-4;
BLORE:R=INTRB1O;

!*** TRANSIT CALL ***!
EXROI:R=INTRT1O,DETY=INTRO,FNC=1;
EXRBC:R=INTRT1O,RGPAR=DIS-2&BLAO-5,RG=10;
BLORE:R=INTRT1O;
```

Figure 10-9: INTRO Routes All TSC Blades

```
!**** Outgoing route towards TSC blades **** !
EXROI:R=INTRT1O,DETY=INTRO,FNC=1;
EXRBC:R=INTRT1O,RGPAR=DIS-2&BLAO-4;
BLORE:R=INTRT1O;

ANRSI:RC=3301,R=INTRT1O,SP=MM1,CCH=NO, ESR=0, ESS=1;
ANRAI:RC=3301;

!**** Incoming route from MSC/TSC blade ****!
EXROI:R=INTRB1I,DETY=INTRO,FNC=2;
BLORE:R=INTRB1I;

EXROI:R=INTRT1I,DETY=INTRO,FNC=2;
EXRBC:R=INTRT1I,RGPAR=BLAO-4;
BLORE:R=INTRT1I;
```

Figure 10-10: INTRO Routes All MSC Blades

ROAMING INTERROGATION - GATEWAY

GRI Route Data

The GRI route is used in two ways, initially to inform the Gateway about the version of the MAP message to send to the HLR and secondly to inform the Gateway how to continue with the analysis on reception of the MSRN or a Call Forward-to-number. The GRI route is a software route, pointing to the GRI function block, which coordinates the Interrogation of the HLR.

Once again only the MSC Blades have the GMSC functionality and GRI routes are only defined in the MSC blades.

```
EXROI: R=0GRI3, DETY=GRI; !STANDARD MAP V3 – INTERROGATION ROUTE   !

EXRBC: R=0GRI3, BO=8, !ORIGIN FOR MSRN ANALYSIS                    !
       RSV=48,        !ERICSSON SERVICES ARE SENT IN EXTENSION AREA!
                      !1-BIT0=SPN, 2-BIT1=ICI, 4–BIT2=OIN          !
                      !8-BIT3=DMSISDN, 32-BIT5=MAPV2               !
                      !48-BIT4&BIT5=MAPV3, 128BIT7=0 USE MAPV2 EXT !
       CO=0,          !CHARGING ORIGIN FOR ROAMING LEG MSRN        !
       MIS1=30,       !ORIGIN FOR ‘FORWARD TO’ NUMBER ANALYSIS     !
       MIS2=2,        !CHARGING ORIGIN FOR FORWARD TO NUMBERS      !
       MIS3=15,       !WHICH ORIGINS ARE TO BE USED:               !
                      !BO=1, CO=2, MIS1=4, MIS2=8                  !
       MIS6=0;        !PLMN INDICATOR, OWN SUBS.DEFINED IN MGISI   !

Application Information: GRI
```

Figure 10-11: Definition of the GRI Route

From the Application Information for the GRI block the values of the SP and CCH parameters can be obtained to define the Routing Case for GRI routes. Remember that the purpose of SP is to determine when and which digits to send to the HLR. There is only one MAP message, so all the digits must have been received.

When defining the GRI route data, it is important to remember that the parameter RSV determines the version of the MAP message, which is sent to the HLR. The BO and CO parameters are used if the returned address is a **MSRN** or the MIS1 and MIS2 parameters are used if the returned address is a **Forward-to Number (C#)**.

From the previous figure, it can be seen that bit 4 & bit 5 determine the standard MAP version to be used. MAP version 3 is required to support CAMEL, GSMs IN solution. For a complete understanding of RSV and all the other route parameters, it is essential to consult the AI for the GRI function block.

Only one GRI route needs to be defined to be able to route the MAP message between the Gateway and the HLR, providing all the HLRs have the same MAP signaling requirements.

The sending of any MAP messages requires the service of SCCP to route the message to the terminating node. In this case, the Gateway sends the message to the HLR. Remember that it is the MSISDN number that is used by SCCP to route the MAP messages to the correct HLR.

SCCP Analysis

A description of SCCP has been given in a previous module. The purpose of this section is to consider the requirements in the Global Title Analysis and the Global Title Routing Case Analysis to support the routing of the MAP messages between the Gateway and the HLR. The HLR to Gateway will also be considered.

The Global Title address being analyzed is in fact the MSISDN received in the MSC Gateway (GMSC). Remember: A Global Title is made up of four parts: Translation Type (TT), Numbering Plan (NP), Nature of Address (NA) and Address Information (AI). The TT value is a default setting. NP is set by the NAPI value from the B-number analysis. NA is set by the BNT value from the B-number analysis and AI (in this case) is the MSISDN.

The Global Titles beginning with 961 3 2, 961 3 3 and 961 3 5 are very straight forward as there is no conflict regarding their use. However, the Global Titles beginning with 961 3 4 are used as Global Titles for: the different node addresses in the PLMN, MSISDNs, MSRNs and BLs. That is why the GT analysis looks so complicated in Figure 10-6. Thought and care are needed to go into these analysis tables.

The Global Title Routing Case (GTRC) points to the cooperating SCCP nodes (a Signaling Point in MTP). The HLR Global Title Analysis data transcript can be simplified if the parameter PTERM is used in the GTRC analysis to allow routing of SCCP messages using the Destination Point Code (DPC). However, there are also disadvantages associated with doing this.

```
!75500,1!
!Definition of Global Title Analysis!
C7GSI: TT=0, NP=1, NA=4, NS 961 32, GTRC=1; !MSISDN TO HLR!
C7GSI: TT=0, NP=1, NA=4, NS 961 33, GTRC=1; !MSISDN TO HLR!
C7GSI: TT=0, NP=1, NA=4, NS 961 32, GTRC=1; !MSISDN TO HLR!
C7GSI: TT=0, NP=1, NA=4, NS 961 401, GTRC=1; !MSISDN TO HLR!
                                  :
C7GSI: TT=0, NP=1, NA=4, NS 961 409, GTRC=1; !MSISDN TO HLR!
C7GSI: TT=0, NP=1, NA=4, NS 961 41, GTRC=1; !MSISDN TO HLR!
                                  :
C7GSI: TT=0, NP=1, NA=4, NS 961 47, GTRC=1; !MSISDN TO HLR!
C7GSI: TT=0, NP=1, NA=4, NS 961 480, GTRC=1; !MSISDN TO HLR!
                                  :
C7GSI: TT=0, NP=1, NA=4, NS 961 487, GTRC=1; !MSISDN TO HLR!
C7GSI: TT=0, NP=1, NA=4, NS 961 4880, GTRC=1; !MSISDN TO HLR!
                                  :
C7GSI: TT=0, NP=1, NA=4, NS 961 4887, GTRC=1; !MSISDN TO HLR!
```

Figure 10-12: DT for Global Title Analysis (1)

```
!75500,1! (cont.)
!Definition of Global Title Analysis!

C7GSI: TT=0, NP=1, NA=4, NS 961 488800, GTRC=1; !MSC4 TO HLR!
C7GSI: TT=0, NP=1, NA=4, NS 961 488810, GTRC=2; !MSC4 TO MSC1!
C7GSI: TT=0, NP=1, NA=4, NS 961 488811, GTRC=3; !MSC4 TO MSC3!
C7GSI: TT=0, NP=1, NA=4, NS 961 488812, GTRC=7; !MSC4!
C7GSI: TT=0, NP=1, NA=4, NS 961 489, GTRC=1; !MSISDN TO HLR!
C7GSI: TT=0, NP=1, NA=4, NS 961 49, GTRC=1; !MSISDN TO HLR!
C7GSI: TT=0, NP=1, NA=4, NS 961 5, GTRC=1; !MSISDN TO HLR!
```

Figure 10-13: DT for Global Title Analysis (2)

You should notice that the number series 961 3 400 is missing from the data shown in Figure. This number series belongs to the BL test phones. For this reason (as they are fixed to a specific switch) we do not need to locate them and hence have no need to define the SCCP GT addressing towards the HLR.

ROAMING NUMBER PROVISION – MSC-S BC

The MSC/VLR receives the MAP message, Provide Roaming Number, and the IMSI will be transferred within the message (in TCAP to be precise).

On reception of this message the MSC-S BC will ensure the MS is attached and then allocate and link the MSRN to the IMSI. The MSRN is then returned to the HLR via a MAP message.

SCCP Analysis

Since the Gateway and the MSC/VLR are physically the same node, the GT analysis given before is used to terminate the MAP message from the HLR. Also the return GT analysis is already defined.

If several HLRs exist, the GT analysis must be entered for each of them.

Provision of Roaming Number

The roaming numbers are provisioned by command using the same sub-file as that for terminating BL calls. They are both local numbers (that is, belong internally to the switch).

For the definition of these roaming numbers the MSRNS (Mobile Station Roaming Number **Series**) and MSRN (Mobile Station Roaming Number) parameters are used. It is important to understand the difference between the two. The MSRN is the number that the call is routed by, for example, 961 3 400200 and the MSRNS are just a series of MSRN range. The MSRNS identifies a MSC-S. In order for the number to be terminated, the analysis must be down to the hundreds group level, for example, 961 3 4002, that is, the MSRN contains two extra digits to that of the MSRNS.

```
!15300,1!
!**** ROUTE CHARACTERISTICS ****!
EXROI:R=MRNR01,  DETY=MRNR;
EXROI:R=MRNR02,  DETY=MRNR;
EXROI:R=MRNR03,  DETY=MRNR;
EXROI:R=MRNR04,  DETY=MRNR;

MGEPC: PROP=MSRNHOMETHOD-0;   !ROAMING / HANDOVER #s!
MGEPC: PROP=MSRNTCNTIME-150;  !VALIDITY TIME OF #s!
MGEPC: PROP=MSRNHNDLIMIT-20;  !#s RESERVED FOR HANDOVER!

!15450,1!
!**** DEFINITION OF ROAMING / HANDOVER NUMBERS ****!
MGRSI:R=MRNR01,  MSRNS=961 3 400 2,  BLDID=0;
MGRSI:R=MRNR02,  MSRNS=961 3 400 3,  BLDID=1;
MGRSI:R=MRNR02,  MSRNS=961 3 400 4,  BLDID=4;
MGRSI:R=MRNR02,  MSRNS=961 3 400 5,  BLDID=5;
```

Figure 10-14: DT to Define the Roaming Numbers Common DT for all MSC and TSC Blades (1)

```
(cont.)

!**** CONNECTION OF ROAMING / HANDOVER NUMBERS ****!
MGRNI:MSRN= 961 3 400 200 && 961 3 400 299; !MSC and TSC Blades!
MGRNI:MSRN= 961 3 400 300 && 961 3 400 399; !MSC and TSC Blades!
MGRNI:MSRN= 961 3 400 400 && 961 3 400 499; !MSC and TSC Blades!
MGRNI:MSRN= 961 3 400 500 && 961 3 400 599; !MSC and TSC Blades!

Only in the MSC Blades:

MGRSC:MSRNS=961 3 400 200 , USAGE=PERM;      !In the MSC Blade 0!
MGRSC:MSRNS=961 3 400 300 , USAGE=PERM;      !In the MSC Blade 1!
MGRSC:MSRNS=961 3 400 400 , USAGE=PERM;      !In the MSC Blade 4!
MGRSC:MSRNS=961 3 400 500 , USAGE=PERM;      !In the MSC Blade 5!
```

Figure 10-15: DT to Define the Roaming Numbers MSC and TSC Blades (2)

Figures 11-18 and 11-19 show the commands required to define the MSRNs for the entire MSC-S BC.

The route definition is straightforward, using the EXROI commands. See the application information for the MRNR block for routes used for either handover or roaming numbers.

There are a number of exchange properties to be specified using the MGEPC command. The important property is the first one listed: MSRNHOMETHOD. This exchange property determines how Roaming Numbers and Handover Numbers are to be allocated. In this instance (MSRNHOMETHOD-0) both sets of numbers are taken from the same group of numbers (that is, the pool of available numbers can be used as either handover or roaming numbers). The exchange property MSRNHNDLIMIT is then available to specify a percentage of the pooled numbers to be reserved for handover purposes only. In this example the parameter is set to 20%, implying that there will always be 20% of the pooled numbers available for handovers. The MSRNHNDTIME parameter that the allocated handover number has a lifetime of 150 seconds after which it would be released.

Once the exchange properties have been specified, the MSRNS are then associated to a route (MGRSI). Each MSRNS points to a route and within each route there are 100 numbers. The USAGE parameter in the MGRSC command is dependent on the MSRNHOMETHOD value.

Note: See the documents: ‘Mobile Telephony Data Changeable Exchange Adaptation’ and the application information for the MRNR block for more information regarding the exchange properties and the values associated to them.

This example shows that there are four MSC blades, and each one of them handles a specific MSRN range. Just in the correspondent MSC Blade will be sent the command MGRSC with the parameter USAGE=PERM. In the TSC Blades the command MGRSC is not sent.

ROAMING REROUTING - GATEWAY MSC SERVER

The MSRN is sent back to the GMSC (function in the MSC Blades) via the HLR. The MSRN is then passed to the analysis function so that a decision as to whether the MSRN number belongs to MSC-S BC (or indeed belongs to any MSC within the own PLMN) or to another PLMN. Once this has been established, the call can be routed accordingly.

The ‘Gateway Roaming Rerouting’ (GRR) function block is now controlling the call.

SCCP Analysis

The GT analysis has already been mentioned during this description. The MAP message contains the MSRN.

Analysis and Routing of MSRN

The analysis of the MSRN is determined by the values in the BO and MIS3 parameters from the route definition of GRI. Remember that the BO parameter is used to direct the MSRN to a particular B-origin, while bit 0 of MIS3 is used to determine whether the BO parameter should be used. Figure 11-8 shows how the MSRN is analyzed and then routed to the correct MSC.

It is important to remember that all roaming numbers from the GRI route are to be analyzed in B-origin 8, in this example, as indicated in the route data, parameter BO=8.

The roaming number could have originated from the MSC4, as well as MSC1 or MSC2, or even from another PLMN where a roaming agreement exists.

In all cases the roaming number will be returned in the international format, BNT=1.

```
!15300,1!
!**** ROUTE CHARACTERISTICS ****!
EXRBC: R=0GRI2, RSV=32, BO=8, CO=1;

!15600,1!
!**** ROAMING NUMBER ****!
ANBSI:B=8-9613400,L=10;
ANBSI:B=8-96134000,RC=3301,BNT=1,CC=1;       !MSC2 MSRN!
ANBSI:B=8-96134001,RC=3301,BNT=1,CC=1;       !MSC2 MSRN!
ANBSI:B=8-96134002,F=9, M=3, BNT=4;          !OWN MSRN!
ANBSI:B=8-96134003,F=9, M=3, BNT=4;          !OWN MSRN!
ANBSI:B=8-96134004,F=9, M=3, BNT=4;          !OWN MSRN!
ANBSI:B=8-96134005,F=9, M=3, BNT=4;          !OWN MSRN!
ANBSI:B=8-96134006,RC=3301,BNT=1,CC=1;       !MSC3 MSRN!
ANBSI:B=8-96134007,RC=3301,BNT=1,CC=1;       !MSC3 MSRN!
```

Figure 10-16: Data Transcript to Analyze the MSRN (1)

```
!15600,1!
!**** ROAMING NUMBER ****!
ANBSI:B=8-9613400,L=10;
ANBSI:B=8-96134000,RC=25,BNT=1,CC=1;  !MSC2 MSRN!
ANBSI:B=8-96134001,RC=25,BNT=1,CC=1;  !MSC2 MSRN!
ANBSI:B=8-96134002,F=9, M=3, BNT=4;   !OWN MSRN!
ANBSI:B=8-96134003,F=9, M=3, BNT=4;   !OWN MSRN!
ANBSI:B=8-96134004,F=9, M=3, BNT=4;   !OWN MSRN!
ANBSI:B=8-96134005,F=9, M=3, BNT=4;   !OWN MSRN!
ANBSI:B=8-96134006,RC=26,BNT=1,CC=1;  !MSC3 MSRN!
ANBSI:B=8-96134007,RC=26,BNT=1,CC=1;  !MSC3 MSRN!

!15400,1!
!**** ROUTE ANALYSIS ****!
ANRSI:RC=25,R=MSC2O,SP=MM1;
ANRSI:RC=26,R=MSC3O,SP=MM1;
```

Figure 10-17: Data Transcript to Analyze the MSRN (2)

If the roaming number belongs to MSC1, MSC2 or to another PLMN then the call will be routed by way of the routing case. This also means that the MSC blade routes via INTRO route to TSC and then TSC blades route via external routing case (external to MSC-S BC).

If the roaming number belongs to MSC-S BC then the analysis continues in origin 9.

RCF Charging

It is possible to charge for this RCF leg (Roaming Call Forward). For charging to take place, a TT record needs to be generated, which can only happen if a charging case is specified in the B-number analysis. The CO parameter, specified in the GRI route data, can then be used as branch parameter within the charging analysis itself with a Charging Case of 1.

ANALYSIS OF MSRN IN RECEIVING MSC/VLR

```
!15600,1!
!**** B-NUMBER ANALYSIS ****!
ANBSI:B=0-034002, F=9, L=8, M=1, BNT=4;
ANBSI:B=0-034003, F=9, L=8, M=1, BNT=4;
ANBSI:B=0-034004, F=9, L=8, M=1, BNT=4;
ANBSI:B=0-034005, F=9, L=8, M=1, BNT=4;

ANBSI:B=1-34002, F=9, L=7, BNT=4;
ANBSI:B=1-34003, F=9, L=7, BNT=4;
ANBSI:B=1-34004, F=9, L=7, BNT=4;
ANBSI:B=1-34005, F=9, L=7, BNT=4;

!**** MOBILE TERMINATING ****!
ANBSI:B=9-34002,MTE,D=3-0,L=7;
ANBSI:B=9-34003,MTE,D=3-0,L=7;
ANBSI:B=9-34004,MTE,D=3-0,L=7;
ANBSI:B=9-34005,MTE,D=3-0,L=7;
```

Figure 10-18: DT to Terminate the MSRN

```
!16000,1!
!**** TELECOMMUNICATION SERVICE ANALYSIS ****!
MGTEI:TEC=THY, TSC=1, CRT=FR-FR, PSCVL=FRV1&FRV2;
MGTEI:TEC=THY, TSC=1, CRT=DHR-DHRC, PSCVL=FRV1&FRV2&HRV1;
MGTEI:TEC=THY, TSC=1, CRT=DFR-DFRC, PSCVL=FRV1&FRV2&HRV1;

MGTEI:TEC=AFX3, TSC=5, TRI=T;

MGTCI:TSC=1, WSIG=NOIS, TBP=NO, TPI=YES, NOTE="THY";
MGTCI:TSC=5, WSIG=ISPR, TBP=YES, TPI=NO, NOTE="AFX3", TCL=6;

!15300,1!
!**** ROUTE CHARACTERISTICS ****!
EXROI:R=MTB, DETY=MTB;        !ROUTE FOR MOBILE TERMINATING!
EXRBC:R=MTB, BO=90, MIS3=0;   !B-ORIGIN USED FOR MT CHARGING!
```

Figure 10-19: Telecommunication Service Analysis

Analysis of MSRN

The roaming number can be received into MSC4 in one of two ways. If the GMSC and MSC/VLR are the same node, then the roaming number will have come from B-origin 8. If the roaming number has been routed from another GMSC, then the analysis will take place in B-origin 0 or 1. In either case the roaming number will be sent to B-origin 9 for the number to be terminated.

In B-origin 9, the analysis is terminated with the MTE parameter, which means a Mobile TErminating call. When the MTE parameter is used, the national MSRNS needs to be generated. The country code, in this example 961, would be generated by the MTRAN.

Note: The MTE parameter is sent in all MSC and TSC Blades.

Telecommunication Service Analysis

When the analysis of the roaming number has been completed, the telecommunication service analysis takes place to analyze the requested service. This data transcript will already have been completed to allow the mobile originating call to take place (see module 8 for information regarding the telecommunication service analysis).

MT Charging

To allow the call to be charged from the MSC to the MS, referred to as the MT (Mobile Terminating) leg or airtime charging, the route data for MTB needs to identify a B-origin. This is done with the BO parameter. BO is only active if bit 0 of the MIS3 parameter is set to 1 (MIS3=1). In the above example airtime charging does not take place, since the MIS3=0.

The B-number that is sent to this table to be analyzed is always in the international format. It is here, in B-origin 90, that a charging case would be generated.

11 Announcement in MSC-S BC

Objectives

Create the exchange data for announcements in the MSS architecture.

- Understand the phrase of announcements.
- Configure access to announcement and the route data.
- Write DT example of announcements

Figure 11-1. Objectives

Intentionally Blank

ANNOUNCEMENTS

Announcements are used to give a subscriber some information as to why a call has not reached through connection or why it may have terminated prematurely.

An announcement consists of one or more phrases. A phrase may consist of tones or words. They are stored on the RAM or the EPROM memory in the announcement system. Each phrase is assigned a unique number. An announcement may consist of up to 32 phrases concatenated together.

An announcement is any kind of speech data, which is to be announced. Each announcement can be split into one or more phrases.

An announcement can consist of fixed and variable phrases. An example is shown in the figure below.

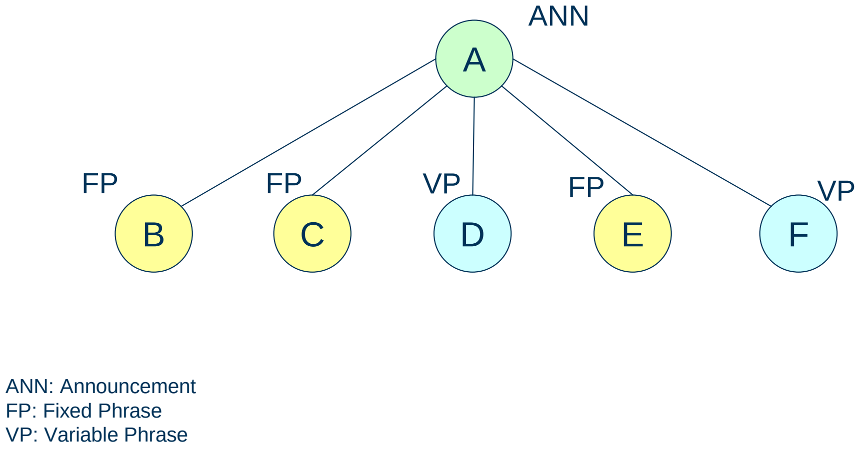


Figure 11-2. Announcement composition

PHRASES

There are two categories of phrases:

1. Pre-recorded phrases
2. Recordable phrases

Pre-recorded Phrases

There are three types of pre-recorded phrases:

- Fixed
- Silent
- Variable

Fixed Phrase

A fixed phrase is a phrase whose content is fixed at the production stage. The phrase content cannot be changed, once it is in service. This type of phrase is used when a high degree of availability of a particular phrase is needed. The following is an example of a fixed phrase:

"The number you have dialed is out of service"

Fixed phrase numbers range from 6-4095 & 34096-62767.

Silent Phrase

A silent phrase number in a message indicates the amount of silence required in that message. All silent phrase numbers are of the format 53XX. So, if 4.5sec of silence is required in a message, then phrase number 53**45** should be used. This phrase number will be converted by the announcement system into the required amount of silence by the concatenation of the correct multiples of 4 smaller silence phrases.

Silent phrase numbers range from 5300-5399

Variable Phrase

A variable phrase is a phrase whose meaning is determined in the exchange, but its actual content is determined on a per call basis by data sent from the user function. An example of a message using variable phrases is:

"Your call has lasted XX minutes and YY seconds"

Where XX and YY are the variable parts.

For example, if a call lasted 5 minutes and 10 seconds, the numeric values "5" and "10" will be supplied by the user function. These will be translated into the required fixed phrase numbers to be used in the complete message:

"Your call lasted five minutes and ten seconds"

Variable phrase number range from 6001-6099

A Recordable phrase is a phrase whose contents are determined by authorized personnel or subscribers using a recording procedure. The authority is based on a pin-code, which is verified in the exchange. Recordable phrases are stored in RAM memory in the announcement system. Recordable phrases are used to create messages, which need to be updated frequently. The following is an example of a recordable phrase:

"The weather forecast for today is warm and sunny"

Recordable phrase numbers range from 10000-26382.

Message Composition

In the terminology of the M-MGw a message composition is a message which is composed of a sequence of other messages. One or more basic messages, variable messages and other message compositions may be the constituents of a message composition.

In general the concept of message composition corresponds to the concept of announcement in the MSC Server with a slight difference; in fact a message composition can contain further message compositions while an announcement in MSC Server can only include fixed and variable phrases.

Below an example figure of decomposing messages.

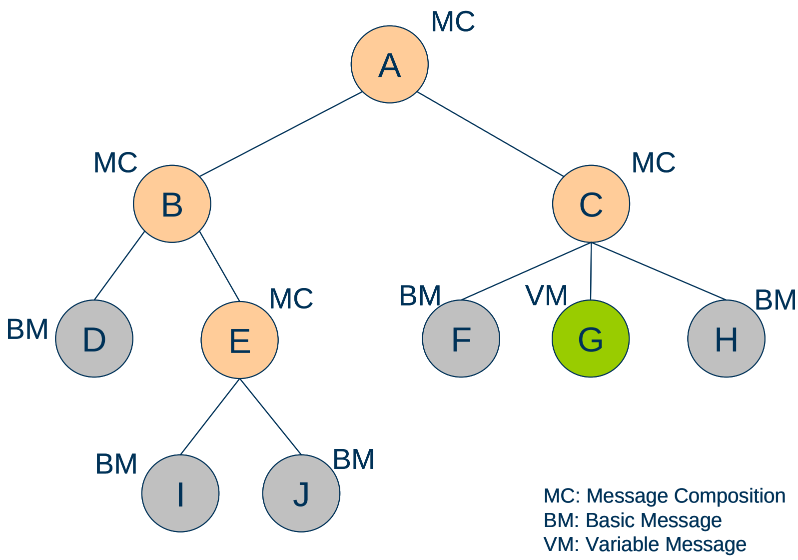


Figure 11-3. Message composition

ACCESSING ANNOUNCEMENTS

Accessing announcements corresponds to accessing a route to which those announcements are tied in exchange data.

For MSS network, which is layered architecture network, announcements are handled in MGW in stead of M-AST in MSC. The announcement data flow in MSC-S as shown in figure below.

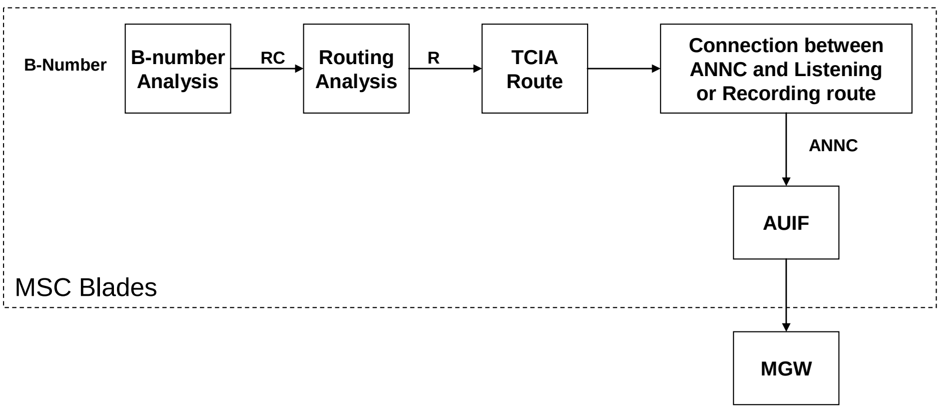


Figure 11-4. Announcement data flow in MSS

In order to have a consistent configuration for announcements, the announcement code in the MSC Server shall match the identifier of the corresponding message in the M-MGw.

In case of fixed announcements, the announcement code in the MSC Server shall correspond to the identifier of a message composition in the M-MGw not including variable messages.

In case of variable announcements, the announcement code in the MSC Server must correspond either to the identifier of a variable message in the M-MGw or to the identifier of a message composition including variable messages.

	MSC Server	M-MGw
Fixed ann.	Announcement code	Message Composition Id or Basic Message Id
Variable ann.	Announcement code	Message Composition Id. or Variable Message Id

Table 11-1. Information to be kept aligned between MSC Server and M-MGw (Ericsson Profile)

It is recommended that the announcements should start with a period of silence of about 1 sec. Reason for this is that some handsets need some time to become ready to receive audio signals after receiving an Alerting Message from the network; if the announcement is immediately started with speech the initial part might not be heard, especially at call set-up.

There are two key function blocks in above data flow, which are

- TCIA:it is used to activate sending or recording of an announcement through B-number and routing case analysis
- AUIF: is an interface block between the announcement user functions and announcement systems. It is used by a user function when it wishes to:
    - send an audible message to a subscriber.
    - receive digits keyed in by a subscriber.
    - record an audible message from a subscriber.
    - duplicate an audible message from or to another system.

In order to route the call to announcement, the announce code (ANNC) can either be defined as called party number in B-number analysis table or be defined as the parameter MB (modification of B-number) which is need to be defined in route data via EXRBC (See Application Information of block TCIA for further information)

Note, that the defined announcement code in route data has priority over the included announcement code in the B-number if an announcement code is defined in both.

Announcement Routes

There are 3 different types of routes in the announcement system.

1. Listening route
2. Recording route
3. Main route

Listening and Recording routes are used for the administration of announcement related data. One listening route corresponds to one recording route with the same phrase number.

Main routes are used for the administration of the devices that connect the announcement system to the Group Switch, which are of ASDH3 type.

These different types of routes are distinguished by assigning them different Function Code (FNC) values in the route definition.

The following FNC values are possible:

- FNC =1 for Main route

An announcement route that allows listening and recording routes to be connected to devices

- FNC =2 for listening route

An announcement route that is used to send announcements to listeners. The route is seized via the Announcement Unit User Interface (AUIF). The announcements may contain fixed phrases, silent phrases, variable phrases and recordable phrases.

- FNC=3 for recording route

An announcement route that is used to record the contents of a recordable phrase. The route is seized via the Announcement Unit User Interface (AUIF).

- FNC=4 for copy route

An announcement route that is used to record the contents of a fixed phrase. The route is seized via the Announcement Unit User Interface(AUIF).

DT EXAMPLE OF ANNOUNCEMENT IN MSS

For MSS network, which is layered architecture network, announcements are handled in MGW in stead of M-AST in MSC. That is to say, M-AST will not exit in MSC. So it is no need to define M-AST hardware DT, main route, and recording route as described previously. The definition is divided into 3 steps:

ANNOUNCEMENT INTERFACE DEFINITION.

Firstly define announcement interface. The example is shown in figure below:

```
 !* TCIA Traffic Control Interface towards ANS *!
EXROI:R=TCIAL1,   DETY=TCIA,     FNC=1; ! LISTINING ROUTE  !
EXRBC:R=TCIAL1,   RSV=516;
EXROI:R=TCIAR1,   DETY=TCIA,     FNC=2; ! RECORDING ROUTE  !
EXRBC:R=TCIAR1,   RSV=516;
     !* AUIF     Announcement Unit User Interface Function *!
EXROI:R=AUIF,     DETY=AUIF;

BLORE:R=TCIAL1;
BLORE:R=TCIAR1;
BLORE:R=AUIF;
```

Figure 11-5. Announcement Interface Definition

ROUTING CASE ANALYSIS DEFINITION

Next step is defining routing case analysis. In the example after routing case analysis, the listening route can be obtained.

```
!* ROUTING CASE FOR AUIF ANNOUNCEMENTS *!

ANRSI:RC=94, R=TCIAL1, CCH=NO, SP=MM1;  !LISTENING!
ANRSI:RC=95, R=TCIAR1, CCH=NO, SP=MM1;  !RECORDING!

ANRAI:RC=94&95;
```

Figure 11-6. Routing Case Analysis Definition

B-NUMBER ANALYSIS DEFINITION

Finally , B-number analysis definition need to be defined. The example is shown in figure below.

```
!* B-NUMBER ANALYSIS FOR ANNOUNCEMENTS *!
! ANNC=3101  The subscriber is absent, please call again later!
! ANNC=3102  Please hold on, your call is forwarded to another number!
! ANNC=3103  The number is not available from this telephone !
! ANNC=3200  The subscriber can not be reached for the moment. Please try again later !
! ANNC=3201  The subscriber can not take your call right now, please try again later!
! ANNC=3202  The subscriber you have dialled have changed number!
! ANNC=3404  Your call is waiting, please hold                                       !
! ANNC=3405  Your call is being put on hold                                          !


ANBSI:B=99-3, L=4, RC=94;   ! EOS ACCESS TO ANNC LISTENING ROUTES!
ANBSI:B=99-8, L=4, RC=95;   ! EOS ACCESS TO ANNC RECORDING ROUTES!
```

Figure 11-7. B-Number Analysis Definition